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AEROPLANE

March 2025
Issue No 623,
Vol 53, No 3

HISTORY IN THE AIR SINCE 1911

WARBIRD MAGIC

IN-DEPTH INTERVIEW

'Black Knight' to Blenheim and beyond: John Romain's life with historic aircraft

MARCH 2025 £5.99
ISSN 0143-7240
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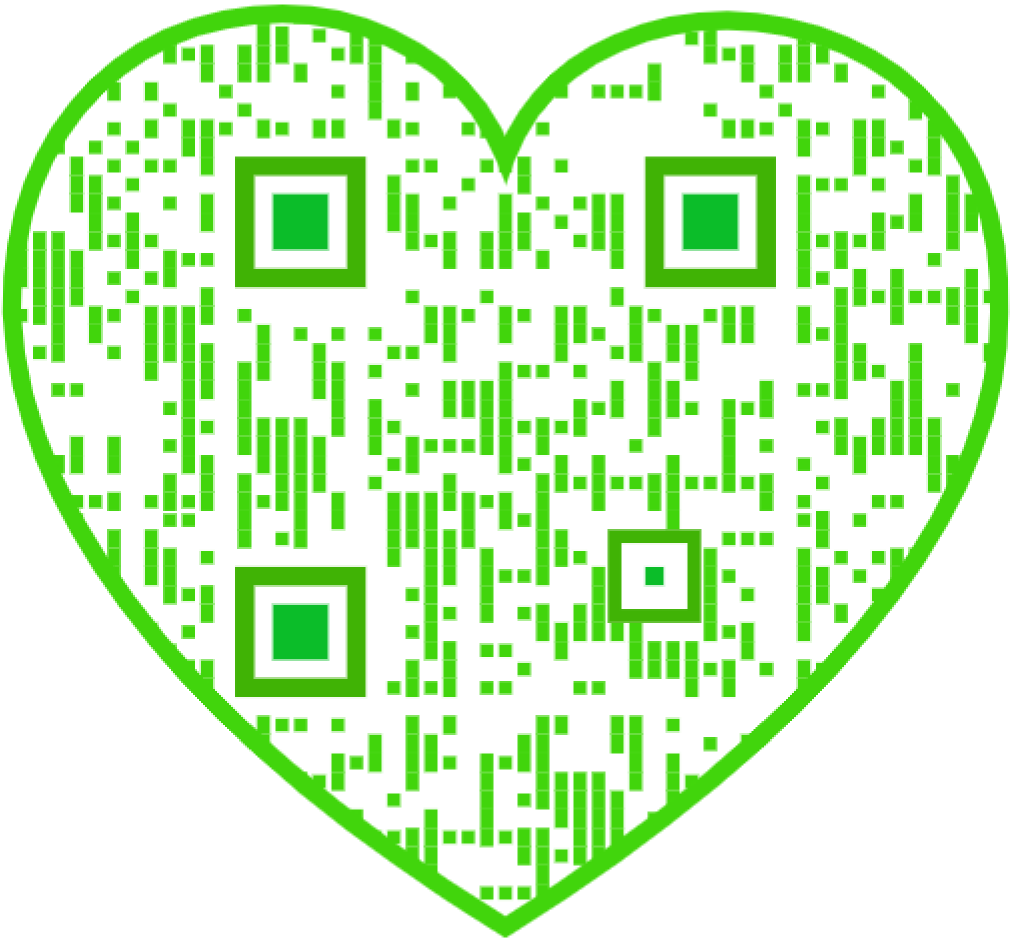
ARROW PROJECT

Avro jet to fly again — well, sort of...

COASTAL COMMAND

Making of a classic wartime film



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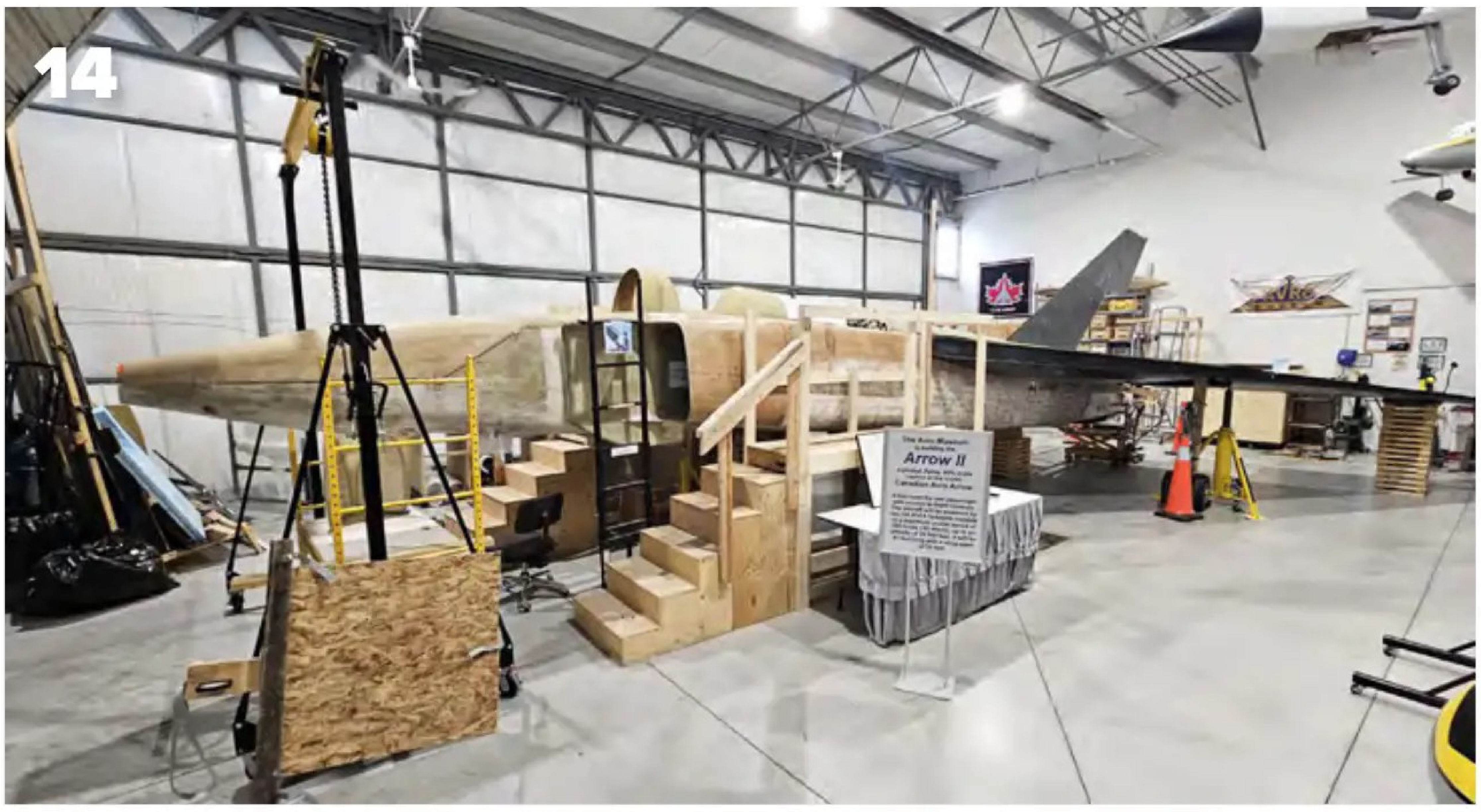

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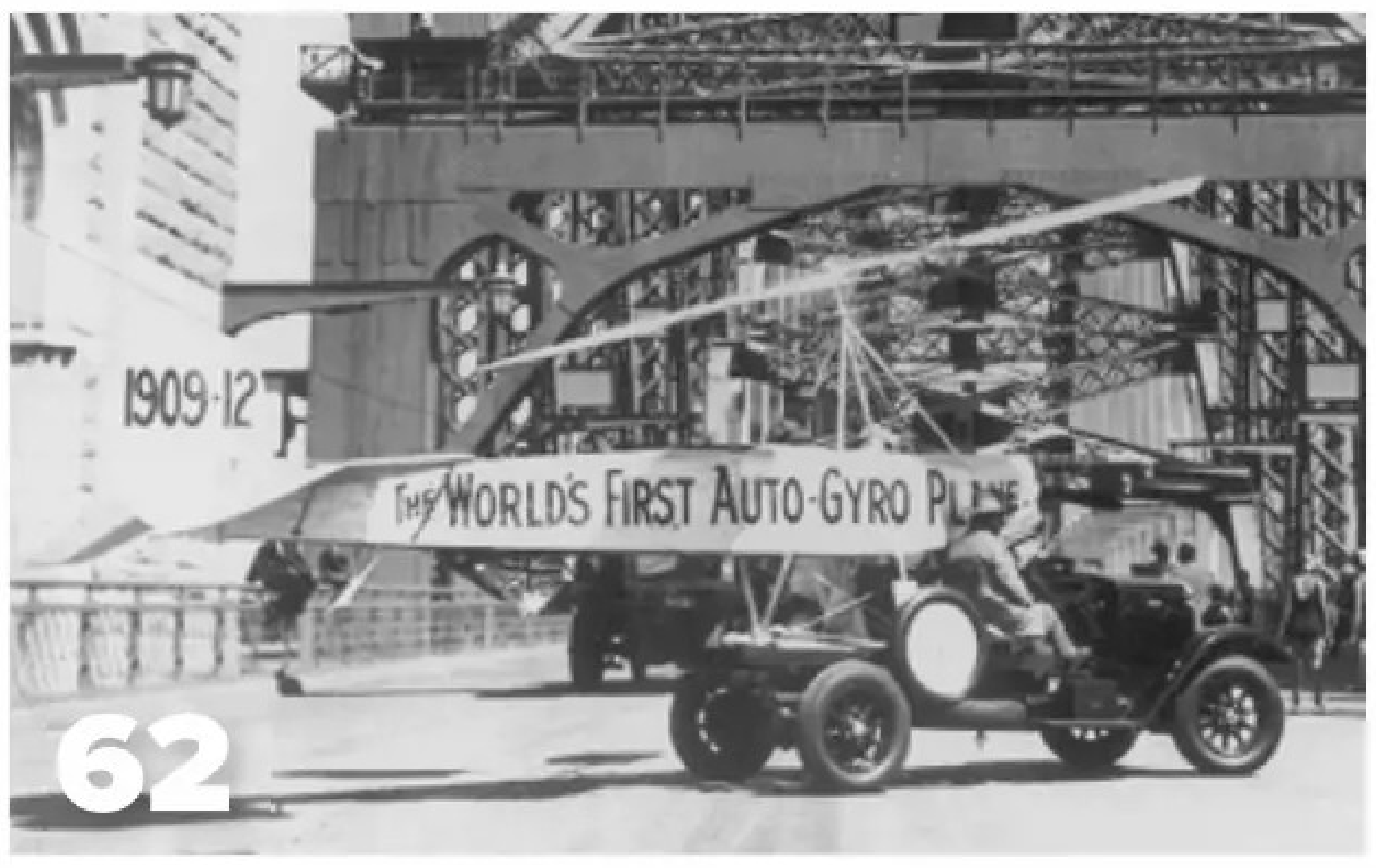

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From the Editor

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Just a few days before we went to press, Storm Éowyn hit the UK and the Republic of Ireland. It was described by the Met Office as probably the strongest storm to have been experienced in Britain for 10 years. Two people were killed and there was widespread damage as gusts in some places exceeded 100mph. Then, as I wrote this editorial, Storm Herminia was in the headlines, with forecasts of 70mph winds around exposed coastal areas and 50mph inland. Why raise this here, you might wonder? Well, in the past, such events have caused harm to historic aviation in this country. Take the hurricane of mid-October 1987, when Edward Hulton's Short Sunderland was dislodged from its beaching gear at Chatham, bending the starboard wing and damaging the floats and stern-post. At Duxford that day, a Max-Holste Broussard was blown into the IWM's Avro Shackleton. Other aeroplanes at different locations were far from immune.

Such weather events were much less common in 1987 than they are in 2025. Our changing climate now means the risk of extreme meteorological occurrences has increased. And this brings with it a need to consider what might happen to historic airframes which continue to be kept outside. This is especially the case given how so many significant large aeroplanes, often very rare or sole survivors, have not been found space under cover. While every effort is taken to park such aircraft in such a way as to minimise the possibility of their being moved in gusty conditions, it cannot be discounted. And with the likes of Storm Éowyn — which affected the Beverley under restoration at Carlisle — being more frequent, the chance is that much greater.

> ***"With extreme weather becoming more common, the chance of damage to aircraft is increased"***

No-one is saying it's the work of a moment, whether for large museums or small groups, but this speaks again to the need for indoor accommodation to be provided for more of our large airframes. In fact, I feel it should be a national heritage priority. These are important artefacts, deserving better than to be left to the mercy of the elements. But who will take the lead?

Ben Dunnell

AEROPLANE
ESTABLISHED 1911

Aeroplane traces its lineage back to the weekly *The Aeroplane*, founded by C. G. Grey in 1911 and published until 1968. It was relaunched as a monthly in 1973 by Richard T. Riding, editor for 25 years until 1998.

THE AEROPLANE
TRIPLEX Safety GLASS

CONTRIBUTORS THIS MONTH

BJOERN BOE

Bjoern obtained his PPL in 1975 while studying for a BSc and flew actively for five years, including four summer holidays to the UK. He joined Braathens and Busy Bee in flight support functions during 1981, then CAA Norway where he started with personnel licencing before moving on to become an aerodrome and flight ops inspector. Bjoern left in 2007 and went solo as a consultant. Returning to CAA Norway in 2016 as an aerodrome inspector, he retired in 2020, but is still active as a consultant.

TONY BUTTLER

While researching and writing his recent book *American Experimental Fighters of WWII*, Tony became aware that relatively little had been published about the various mixed-powerplant fighters built and flown in the US. After checking existing sources, bringing the types together as a Database seemed an original approach and would, in the process, make *Aeroplane* readers more aware of these efforts to produce a good aircraft. In the end only the Ryan Fireball entered service and then for just a short period, but these fighters deserve more attention.

JOHN EVANS

A former journalist, John's deep interest in aviation history led easily into research and documentation of the flying boat era and its long connections with his then home town, Pembroke Dock. He guided heritage initiatives, including five 'PD' flying boat reunions, culminating in the royal opening of the Pembroke Dock Heritage Centre in 2014, the year he was awarded the British Empire Medal. The centre, of which John is patron, has a special focus on flying boats, particularly the Short Sunderland. John's books include three pictorials on the Sunderland and two squadron histories.

NIGEL SCRASE

After graduating in aeronautical engineering and design and completion of an apprenticeship with BAC/BAe, Nigel worked as an aerodynamicist in the aircraft industry for over 40 years. Moving from the sublime Concorde to ethereal airships, then to aircraft propellers and finally helicopters, there was never a dull moment. He is interested in the science and art of engineering design. The Westland Wyvern was a bundle of fascinating, and risky, developments, and its propeller has not attracted a detailed examination before the article in this issue.

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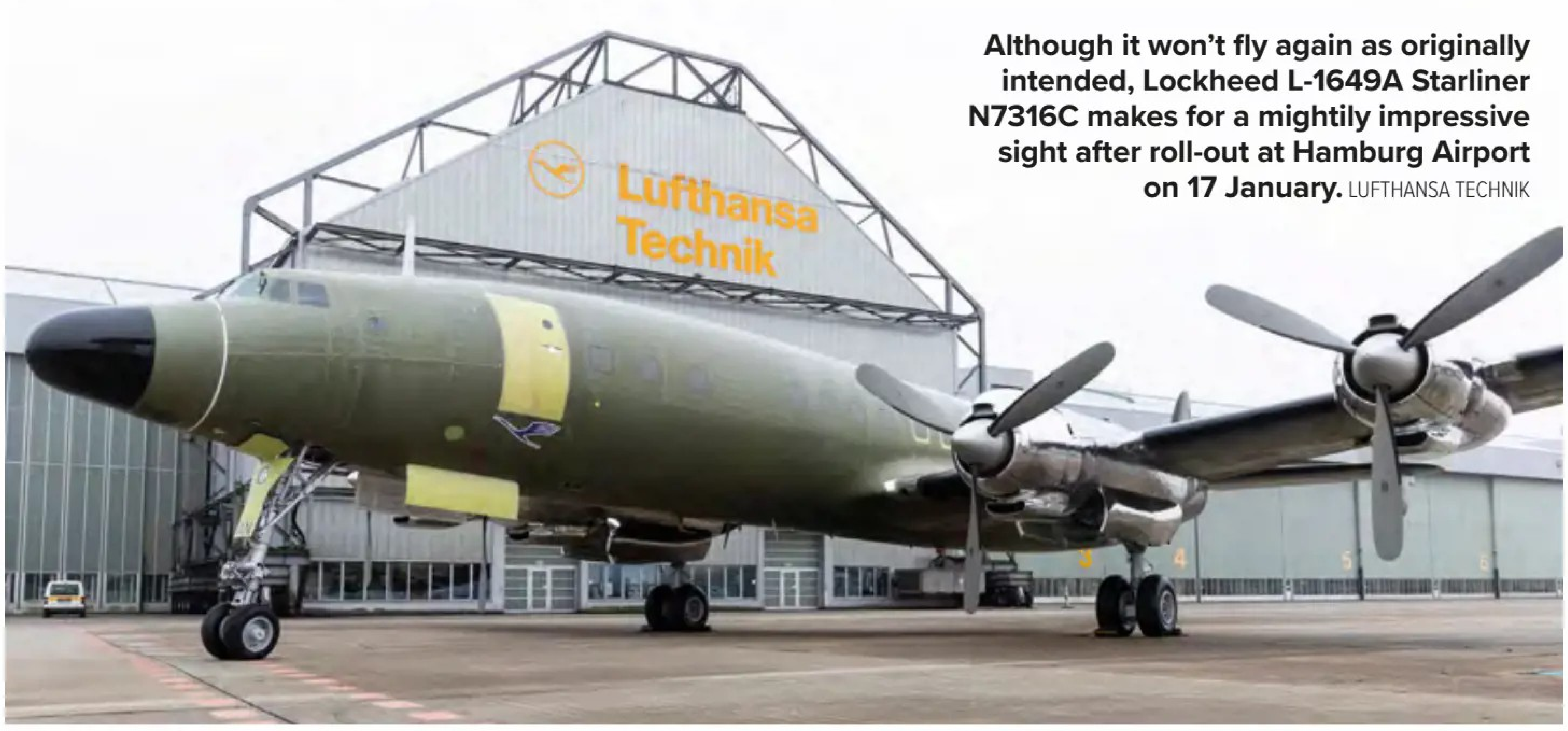
Lufthansa Starliner unveiled in Hamburg

On 17 January, Lockheed L-1649A Starliner N7316C was rolled out from the Lufthansa Technik facility at Hamburg, from where Lufthansa's four L-1649s — given the Super Star Constellation name in the West German flag-carrier's service — were maintained and operated as the airline's flagships on the non-stop trans-Atlantic route to New York between 1957 and 1960.

The only example of Lockheed's ultimate piston-engine airliner preserved in Europe, N7316C will be transported to Münster/Osnabrück Airport during July, where it will be painted in Lufthansa colours, including the so-called 'parabola' design on its triple tail. Once completed, the L-1649A is scheduled to arrive in Frankfurt during October, where, alongside Junkers Ju 52/3m D-CDLH, it will go on display at the Lufthansa Group's new conference and visitor centre which is due to open in the spring of 2026 for the airline's centenary year.

On the twice-weekly, exclusive 'Senator'-class Hamburg-New York flights Lufthansa L-1649As were fitted out with just 12 first-class and 20 deluxe reclining seats. If necessary, four of the first-class seats could be converted into sleeping berths for services that could take up to 17 hours. The airline also flew the type on its Canada, South America, Middle East and Near East routes.



Although it won't fly again as originally intended, Lockheed L-1649A Starliner N7316C makes for a mightily impressive sight after roll-out at Hamburg Airport on 17 January. LUFTHANSA TECHNIK

As the Starliner's brief moment of glory with the West German carrier ended — courtesy of the Boeing 707 during 1960 — two examples went back to Lockheed at Burbank for conversion into trans-Atlantic freighters, with strengthened floors and upward-opening freight doors on either side of the fuselage. The other two were handed down to Condor Flugdienst, Lufthansa's charter subsidiary, and operated for a further two years.

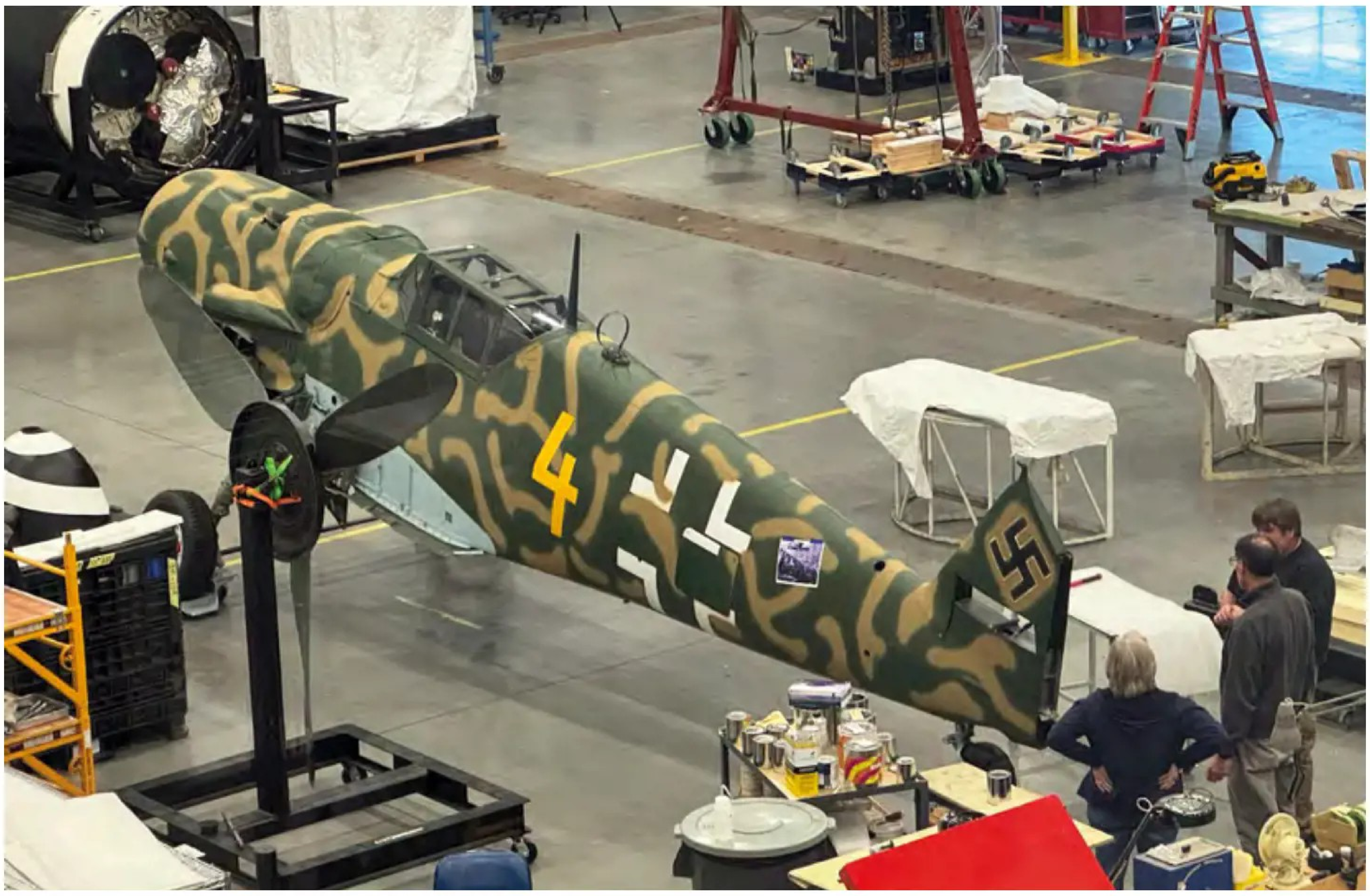
L-1649A N7316C was acquired at auction on 18 December 2007 at Auburn-Lewiston Airport, Maine by the Deutsche Lufthansa Berlin-Stiftung, along with L-1649As N974R and N8083H, all three airframes having previously been kept at Maurice Roundy's Maine Coast Airways facility at Auburn-Lewiston. Roundy had started restoring N7316C to airworthy condition in August 2002, nearly 20 years after it had flown in to the airport. During 2008 Lufthansa began a mammoth project to return the machine to the air, with reassembly getting under way during 2014, but management pulled the plug on the effort in March 2017. The airliner arrived at the port of Bremen on 1 October 2019, and the following May the Lufthansa CEO stated that the aborted project to get N7316C back into the air had cost $162 million.

After initial storage in a Bremen warehouse, the task of moving N7316C to Paderborn, 30 miles south of Bielefeld, for temporary storage began in February 2021, the fuselage, wings, triple tail and 292 wooden crates containing a mass of parts subsequently arriving in Hamburg during October 2023.

Ownership of N974R — originally delivered to Lufthansa in December 1957 as D-ALAN — was transferred to the Fantasy of Flight Museum at Polk City, Florida during 2011, the machine having been on display there, initially on loan, since flying in on 19 October 2001. From 12-24 March 1960, D-ALAN carried West German head of state Chancellor Konrad Adenauer on a tour of the USA and Japan, calling at New York, Washington DC, San Francisco, Palm Springs and Los Angeles. It arrived in Tokyo on 25 March, having staged through Honolulu and Wake Island. The first polar crossing by a Lufthansa aircraft was achieved on the return journey, 'ALAN flying back home via Anchorage and Keflavík.

N7316C never actually flew with Lufthansa, having been delivered to TWA in June 1957 with the name *Star of Tigris.* It flew its last passenger service on 9 September 1960, but continued to fly with TWA as a freighter until being leased to Alaska Airlines in January 1962. During 1968 it was converted to a bulk fuel carrier. '7316C spent much of the remainder of its flying career in Alaska, before being abandoned at Stewart Airport, New York in July 1976, and saved by Roundy in May 1983. The supremely elegant machine made what turned out to be its final flight to Auburn-Lewiston Airport on 9 November 1983.

NASM 'GUSTAV' BACK IN ORIGINAL SCHEME



In the Mary Baker Engen Restoration Hangar at the NASM's Steven F. Udvar-Hazy Center at Dulles Airport, Washington, just before Christmas, the fuselage of Bf 109 G Werknummer 160756 has been repainted in its original III./JG 4 green-and-tan camouflage scheme as worn in Italy during July 1944. PHILIP OAKLEY

The repaint of the National Air and Space Museum's Messerschmitt Bf 109 G-6 Werknummer 160756 back into its original markings was under way at the Mary Baker Engen Restoration Hangar at Dulles, Washington during December, in readiness for the fighter's move back to the National Mall in Washington DC where it will go on display in the NASM's new Jay I. Kislak WWII in the Air Gallery when it opens during 2026.

Prior to its previous restoration in the early 1970s, the machine's primary dataplate had disappeared and the original paint had long been stripped off, so the fighter — with reference to wartime photographs — was painted to represent a Bf 109 G-6, Werknummer 160163, operated by Jagdgeschwader 27.

Subsequent research revealed the true 160756 identity in the cockpit under a coat of paint that had been applied during the previous restoration. With the many fighters previously on display in the Mall facility being removed from display during construction work, it was decided to take the opportunity to restore 160756 in its original markings.

On 25 July 1944, conscripted French pilot René Darbois — who had chosen to join the Luftwaffe in preference to being drafted into the Waffen SS — took off in 160756 'Yellow 4' of III./Jagdgeschwader 4 from Maniago, north-eastern Italy heading for Ghedi airfield near Lake Garda, the unit having been redeployed to homeland defence duties in Germany.

The Messerschmitts had been fitted with 300-litre drop tanks, giving Darbois a golden opportunity to do what he had long planned, and defect. Faking a mechanical problem, Darbois detached from the other 15 Messerschmitts on the formation ferry flight, and once out of sight set course for Allied-occupied southern Italy, landing at Santa Maria Capua Verde airport, 25 miles north of Naples, much to the surprise of resident US Army Air Forces personnel.

The recent repaint was completed with reference to both photographs and film footage taken shortly after Darbois' arrival. In Luftwaffe service in Italy, the fighter had its factory-applied European theatre of operations scheme over-sprayed with what AAF personnel described as a crudely painted green and tan camouflage. The Messerschmitt was then shipped to Freeman Field, Indiana for flight testing with the foreign equipment identity FE-496, which was later changed to T2-496. During 1946 it was saved from scrapping and allocated to the Smithsonian Institution.

Darbois ended the war flying Spitfires with Groupe de Chasse 1/3 'Corse', staying in the military post-war to become a Sikorsky S-55 rescue helicopter pilot in Indochina. Following the battle at Dien Biên Phu, Darbois was made a Knight of the Legion of Honour, but after returning home to Étampes on leave, and unhappy about fighting a colonial war, he committed suicide on 14 February 1955 at the age of 31.

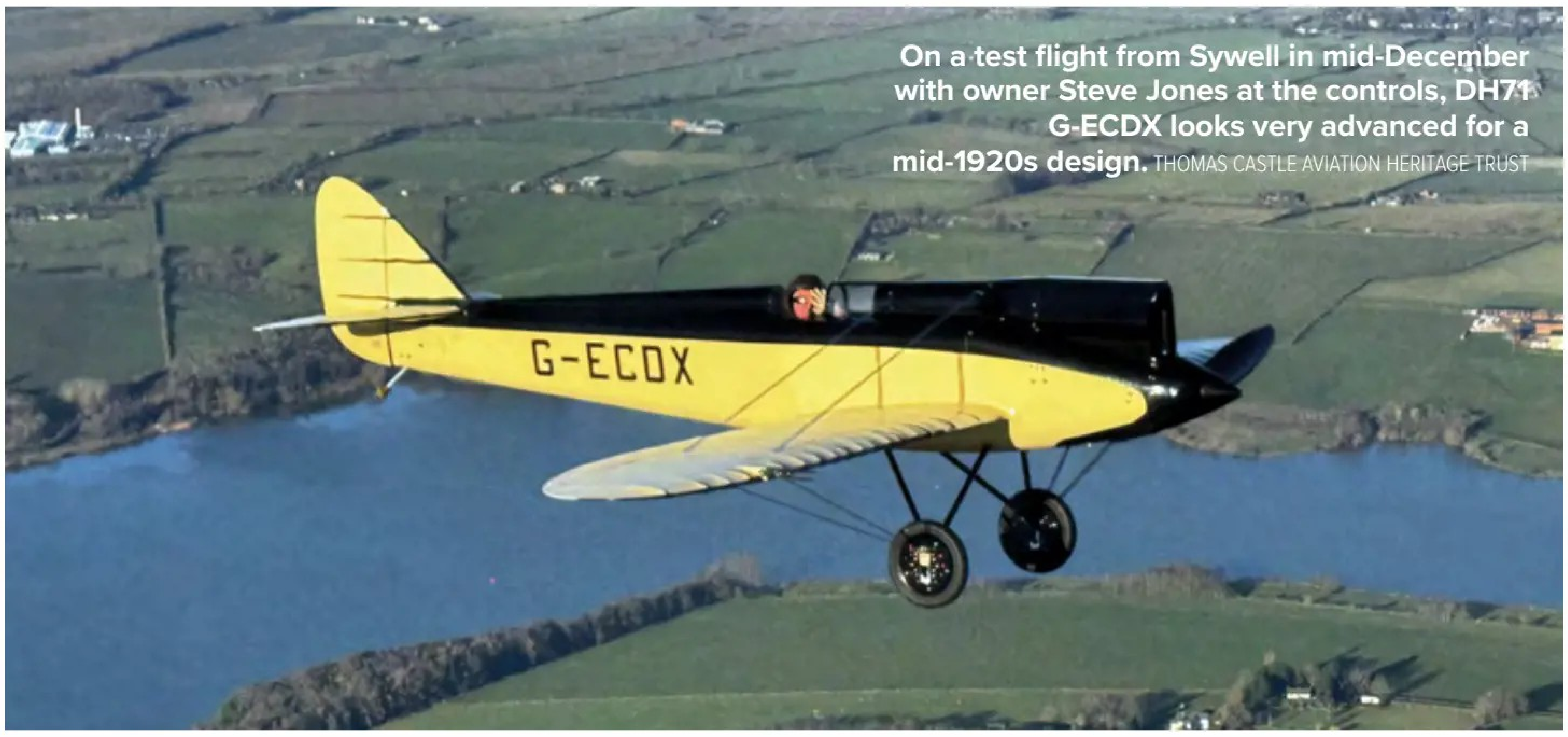
Hucknall flight test museum to reopen

The Hucknall Flight Test Museum, located at the former Rolls-Royce aero engine site in Nottinghamshire, will be officially opening to the public on 5 April. Repairs and exhibit refurbishments have been conducted, and donations made to the collection by, among others, the RAF Museum such as an early Welland jet engine and a sectioned Merlin 24, along with smaller artefacts from the Rolls-Royce Heritage Trust and the company photographic department. All of them help tell the story of testing at Hucknall.

The museum will be open for booked visits on an appointment basis. Donations are requested rather than an entry fee, with suggested minimum contributions of £8.00 per adult and £5.00 for children. For further details visit hufm.com. ***Ben Dunnell***

The engine hall at the Hucknall Flight Test Museum has been significantly upgraded in readiness for reopening in April. HUFTM

DH71 Tiger Moth monoplane replica airborne



On a test flight from Sywell in mid-December with owner Steve Jones at the controls, DH71 G-ECDX looks very advanced for a mid-1920s design. THOMAS CASTLE AVIATION HERITAGE TRUST

For the first time in 95 years, a de Havilland DH71 Tiger Moth monoplane took to the skies over the UK on 26 November, with former Red Bull Air Race competitor, and well-known aerobatic and warbird pilot, Steve Jones at the controls.

Construction of G-ECDX, a reproduction of de Havilland's pair of 1927 high-speed research and racing monoplanes, was begun by the late Ron Souch at his Aero Antiques workshop in Hampshire during 1994, but work had long halted before Steve Jones acquired it in 2016 and relocated the part-completed aeroplane to his premises in Gloucestershire.

Steve explains to *Aeroplane*, "I saw the abandoned DH71 project fuselage, lying on its side under heaps of rags and dust. It had lain like that for many years. I had never heard of the type, but even in its dishevelled state I was struck by how pretty it was. I could not walk away and allow it to remain unloved! I was warned that, due to the fragility of the structure, progressing it towards flight would be a major headache. Eventually, Ron and Mike Souch agreed to sell it to me. They were right — getting it flying was a major headache!

"In 1927-28 one of the two highly experimental originals had managed a speed of 186mph. Modern aeronautical stress calculations had shown this to be worryingly close to likely structural disaster. If it was going to fly in the modern world, it would need to settle for a lower maximum speed. If it looked beautiful and fast, I would be happy.

"Due to the unique design, many of the in-flight loads pass through the wheels and undercarriage. Internal modifications were required to increase wing and undercarriage strength. Everything had to be completed with minimum weight gain. It has a stock Gipsy 1 engine in place of the high-compression version that Hubert Broad [the de Havilland test pilot] used.

"It has a great power-to-weight ratio, very little aerodynamic drag, light and powerful controls, but very little stability. It is a nice aeroplane to fly, but in the air it can't be left unattended for a moment. A real character. The first public appearance of G-ECDX should be Shuttleworth's Season Premiere Air Show at Old Warden on 11 May."

Coventry's Whirlwind gets TLC

Now under cover after many years on external display at the Midland Air Museum at Baginton, Coventry, the restoration of 66-year-old Westland Whirlwind Series 3 G-APWN is now under way. The machine made its maiden flight on 3 October 1959, being delivered to Bristow Helicopters in 1963. The well-travelled Whirlwind flew with the company in Nigeria as 5N-AGI and Bermuda as VR-BER prior to retirement in 1981 at Redhill.

The chairman of the board of trustees at MAM, Barry James, says, "These early helicopters aren't built to stay outside, having been constructed light with thinner-gauge metals. This Whirlwind also operated off floats with Bristow's, so corrosion is an issue. It had reached the point where, if we didn't get it inside, it would deteriorate to the extent of making restoration unfeasible. But now we have a three-man team of volunteers on it, so it has a future, and will be repainted in Bristow markings."

RIGHT: In primer at Coventry on 17 January, the Midland Air Museum's Whirlwind Series 3 G-APWN is due to be painted back into its red, white and blue Bristow Helicopters livery. TONY HARMSWORTH

SHACKLETON TO THE FROZEN NORTH

In the midst of heavy snow, ice, and freezing temperatures exacerbated by strong winds, Avro Shackleton MR2 WR963 arrived at the Elvington home of the Yorkshire Air Museum in several loads from Coventry Airport between 4 and 9 January. On 5 January, the day after the first major section — the starboard wing — arrived, the museum was forced to shut to the public due to the amount of lying snow. The fuselage was unloaded on 8 January, with all major sections being in situ by the 9th.

YAM director Jonathan Brewer said, "It's great to see all the sections of the Shackleton finally arrive. It's taken a huge effort by the teams both at Coventry and here at Elvington to get to this point, particularly given the atrocious weather we had last week. They worked through freezing cold and soaking wet conditions to get huge chunks of the aircraft loaded, transported and unloaded."

M
GP CAPT DAVE HENCKEN

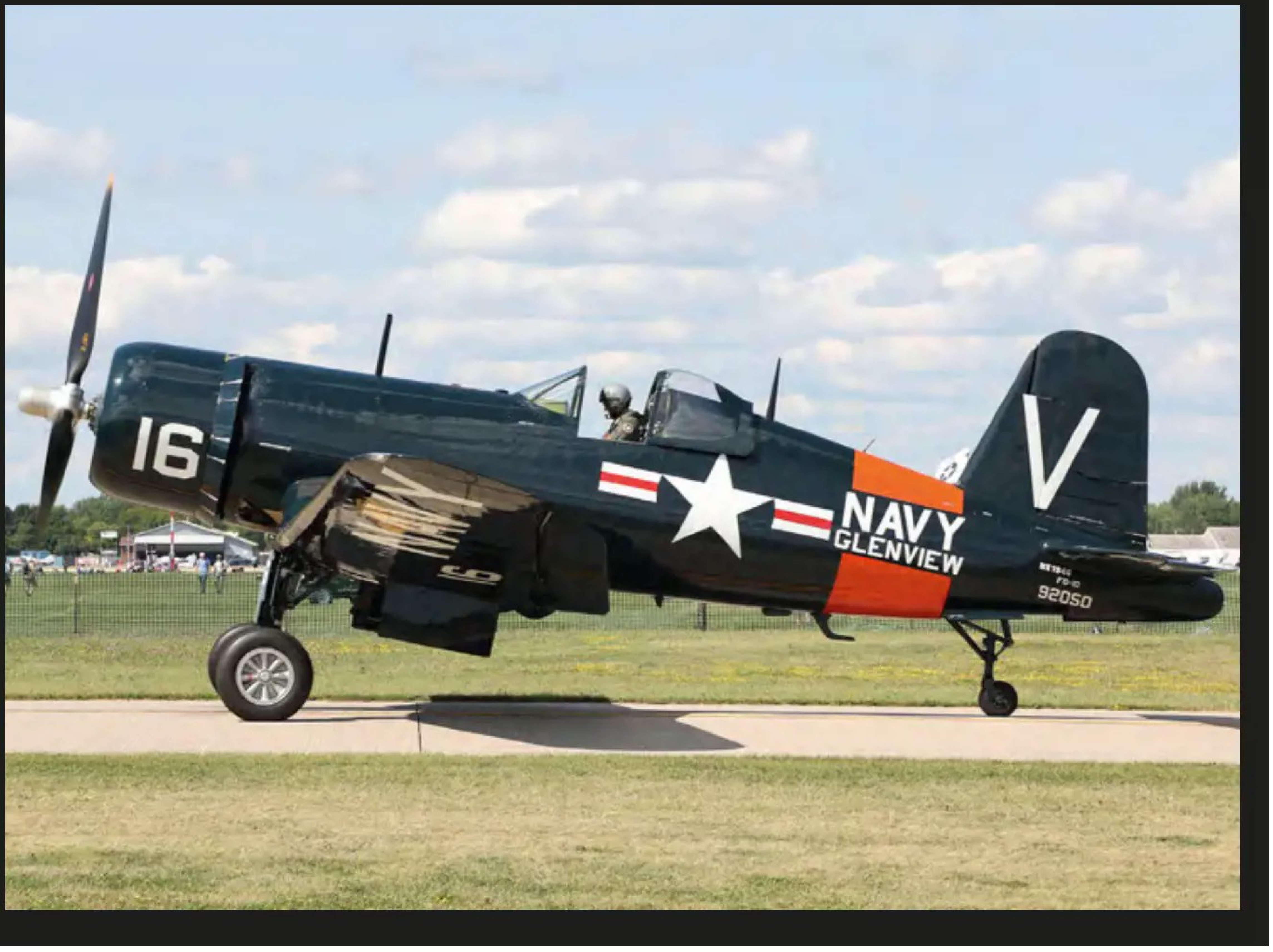
ABOVE: The nose of Shackleton WR963 safely bedded down at Elvington after its arrival from Coventry on 8 January. The aircraft will now be reassembled and, in time, returned to ground-running condition. YAM

LEFT: The rear fuselage road-running during the freezing night of 7 January. YAM

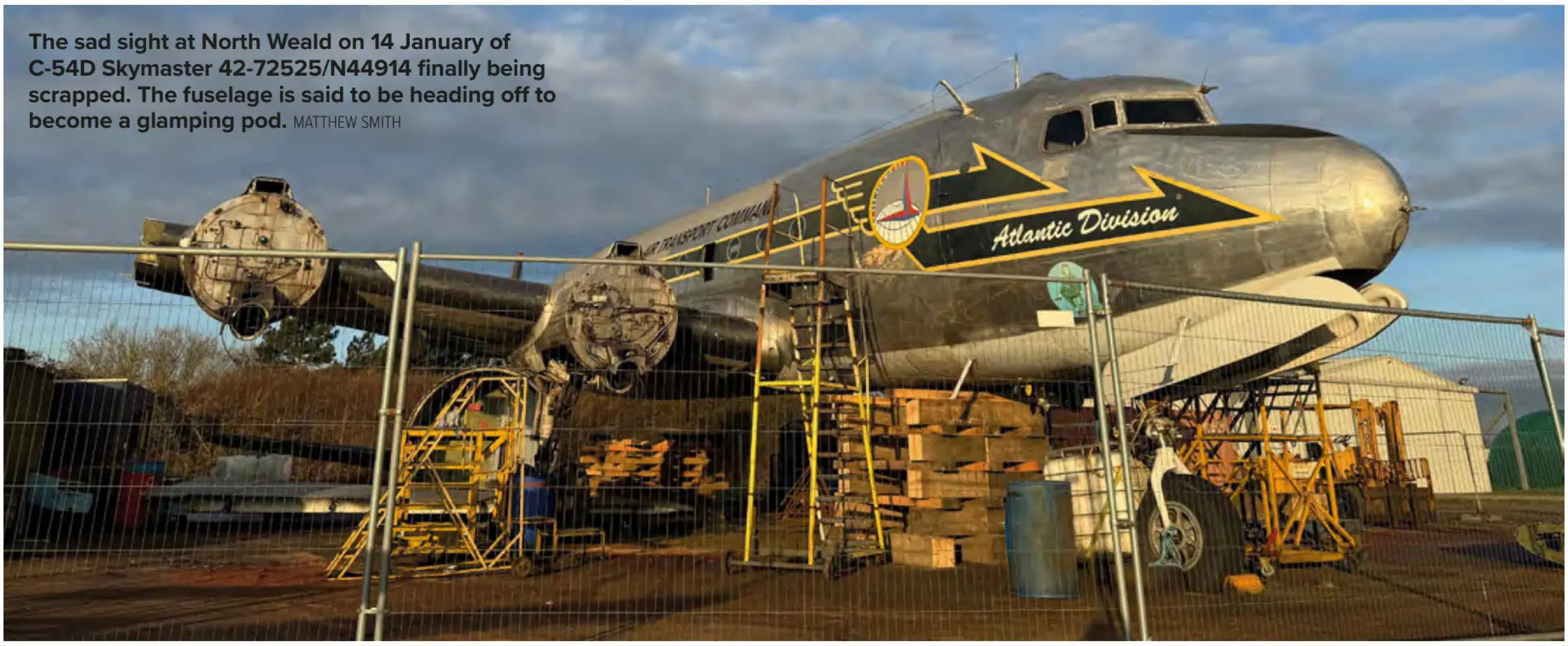
CORSAIR HEADING TO CANADA

Timmermans Legends of Flight announced the acquisition of Goodyear FG-1D Corsair BuNo 92050/N194G on 24 January, and the 1945-built fighter is scheduled to arrive at the organisation's Chatham-Kent Municipal Airport base in Ontario, Canada, soon.

The machine was previously owned by the Warbird Heritage Foundation at Waukegan National Airport, Illinois, and took to the air after an eight-year restoration in March 2021. The Timmermans collection also includes Supermarine Spitfire XVIII TP280/C-GANI, Messerschmitt Bf 109 G C-FDOR, TF-51D Mustang C-FPWT, Hawker Sea Fury FB11 TF987/C-FPSF, and Mitsubishi A6M2 Zero N8280K.



RIGHT: Pictured at Oshkosh in July 2022 while operated by the Warbird Heritage Foundation, FG-1D Corsair BuNo 92050/N194G wears the markings of an NAS Glenview training aeroplane. NIGEL HITCHMAN


The sad sight at North Weald on 14 January of C-54D Skymaster 42-72525/N44914 finally being scrapped. The fuselage is said to be heading off to become a glamping pod. MATTHEW SMITH

Weald Skymaster scrapped

More than 22 years after its September 2002 arrival at North Weald from the USA for a proposed Steven Spielberg-directed HBO film about the Berlin Airlift, Douglas C-54D Skymaster 42-72525/N44914 was scrapped at the Essex airfield during January. Its former stablemate, DC-4 44-4291/N31356 — flown from Avra Valley, west of Tucson, Arizona, to North Weald in late September 2002 for the same production — was scrapped during December 2015, the nose section going to the RAF Burtonwood Heritage Centre in Cheshire.

During December 2017 historic aircraft broker Allan Vogel formed the Save the Skymaster charity, aiming to restore the aeroplane to flying condition. The volunteer team got three of the Pratt & Whitney R-2000 Twin Wasp engines running, but a survey discovered the main spar and wings would need to be replaced, at an estimated cost in excess of £300,000. With the very real potential that other undiscovered areas of corrosion would emerge, and promised funding not forthcoming due to the COVID-19 pandemic, the group stated, “proceeding with such a significant financial burden would not be prudent”. Save the Skymaster was wound up in February 2024. The complete fuselage and nose section of 42-72525 is destined to become a glamping pod at a so far undisclosed location.

Built for the US Army Air Forces at the Douglas plant in Chicago, Illinois — now part of the site of O’Hare Airport —the C-54 was transferred to US Navy transport squadron VR-11 in Guam, being redesignated as an R5D-3 and given the serial BuNo 56498. The unit was at the time the largest squadron in the US Navy, with a total of 89 R5D Skymasters and 10 R4D Skytrains on charge. BuNo 56498 was then used to deliver vital medical supplies to Iwo Jima, and flew many evacuation missions for GIs. During 1946, it repatriated British prisoners of war from Burma, and went on to see service in the late 1960s delivering supplies from Guam, Japan and the Philippines during the Vietnam War.

Retired from the military in 1972, it then spent some time at Chandler, Arizona, on insecticide spraying work, subsequently being acquired by Atlantic Warbirds, registered N44914, and displayed at predominantly east coast airshows wearing Air Transport Command Atlantic Division markings.

NEWS IN BRIEF

SABRE FOR SHUTTLEWORTH SHOW IN JULY

On 17 January, the Shuttleworth Collection announced that Mistral Warbirds’ Avignon-based Canadair Sabre 6 F-AYSB (right), will display at Old Warden’s Summer Air Show on 26 July in the hands of owner Frédéric Akary. The Sabre is also due at the Midlands Air Festival on 30 May-1 June and the Old Buckenham Airshow on 26-27 July.

BEN DUNNELL

GNAT DISPLAY TEAM VACATES WEALD

On 20 December, the Gnat Display Team’s last two North Weald-based aircraft, the former Indian Air Force single-seat Gnat F1 IE296/G-SLYR and Gnat T1 XR537, left the Essex airfield by road for a new home at St Athan.

BEVERLEY DAMAGED BY ÉOWYN

Storm Éowyn hit the Solway Aviation Museum at Carlisle on 25 January, the 80mph wind gusts damaging the nose, wing parts and fuselage of the currently dismantled and recently relocated Blackburn Beverley C1 XB259. The museum stated, “It’s nothing we can’t deal with, but will inevitably add to our restoration costs.”

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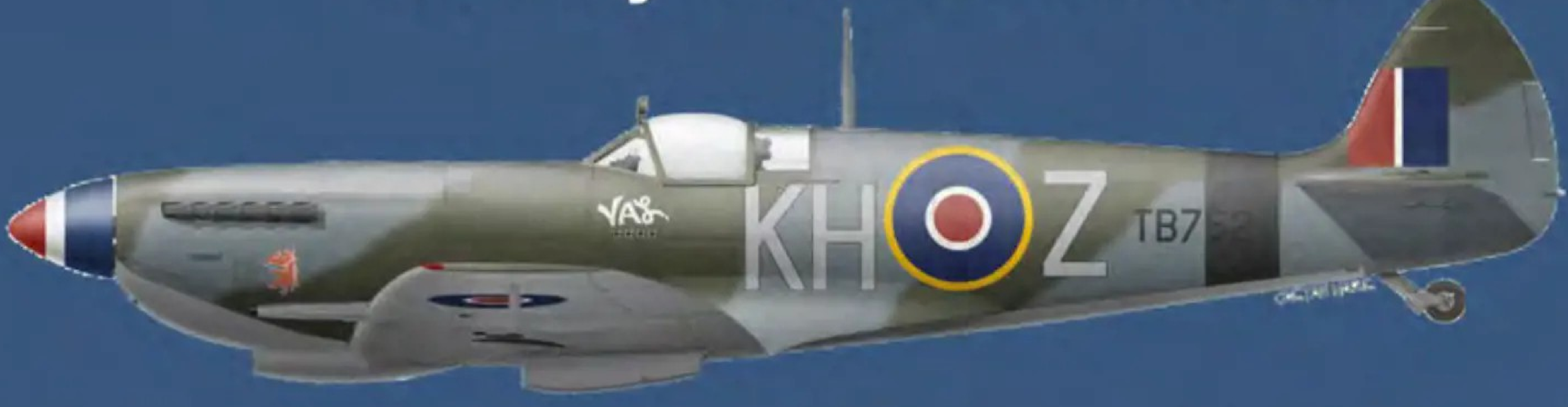
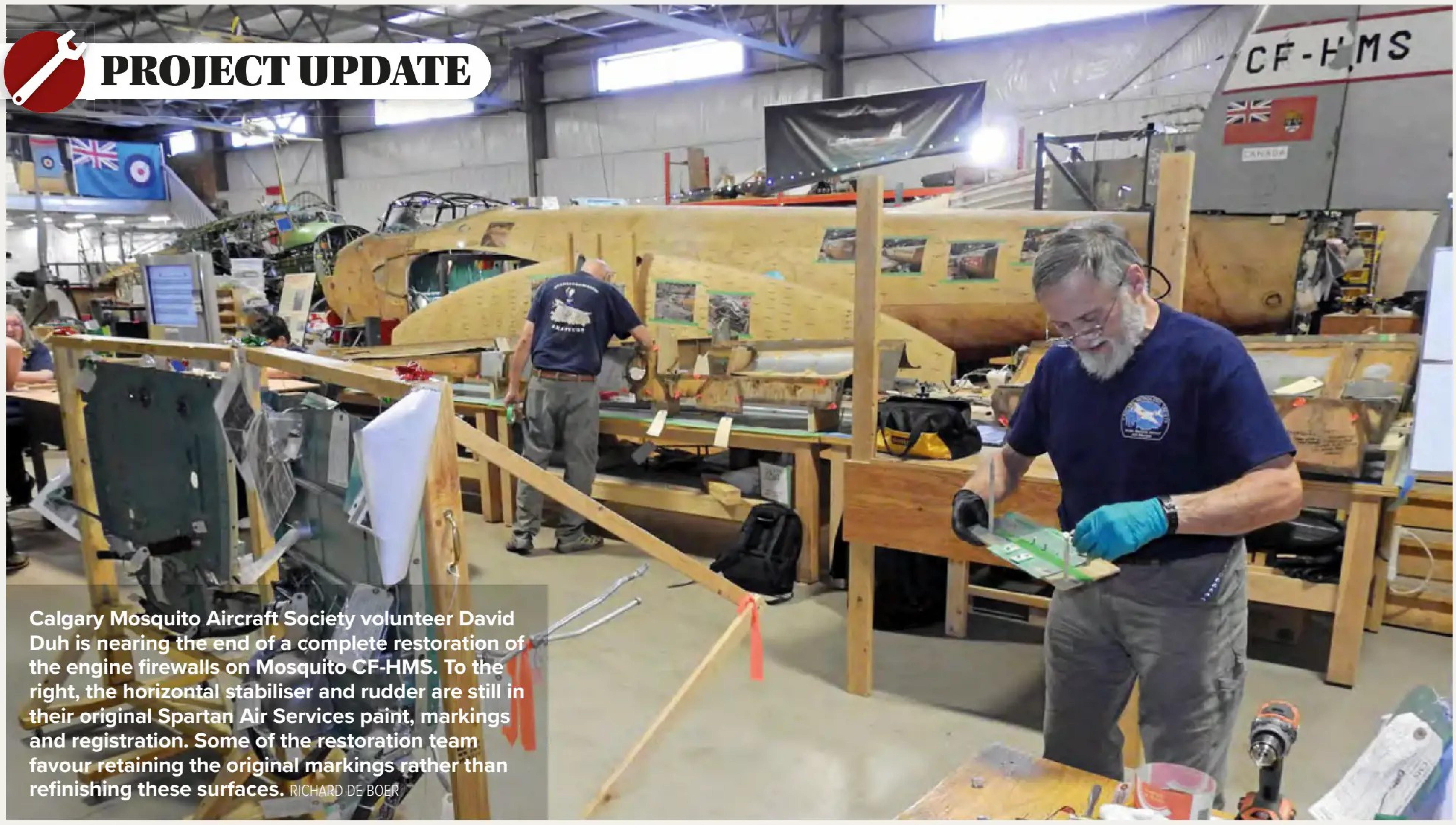


@SpitfireHurricaneMemorialMuseum

PROJECT UPDATE



Calgary Mosquito Aircraft Society volunteer David Duh is nearing the end of a complete restoration of the engine firewalls on Mosquito CF-HMS. To the right, the horizontal stabiliser and rudder are still in their original Spartan Air Services paint, markings and registration. Some of the restoration team favour retaining the original markings rather than refinishing these surfaces. RICHARD DE BOER

Calgary Mosquito advances 60 years on

Sixty years after it arrived in Calgary, Alberta for preservation, restoration of former Spartan Air Services de Havilland Mosquito PR35 RS700/CF-HMS is now progressing well with the Calgary Mosquito Society in a workshop at the Bomber Command Museum of Canada in Nanton, 60 miles south of Calgary International Airport.

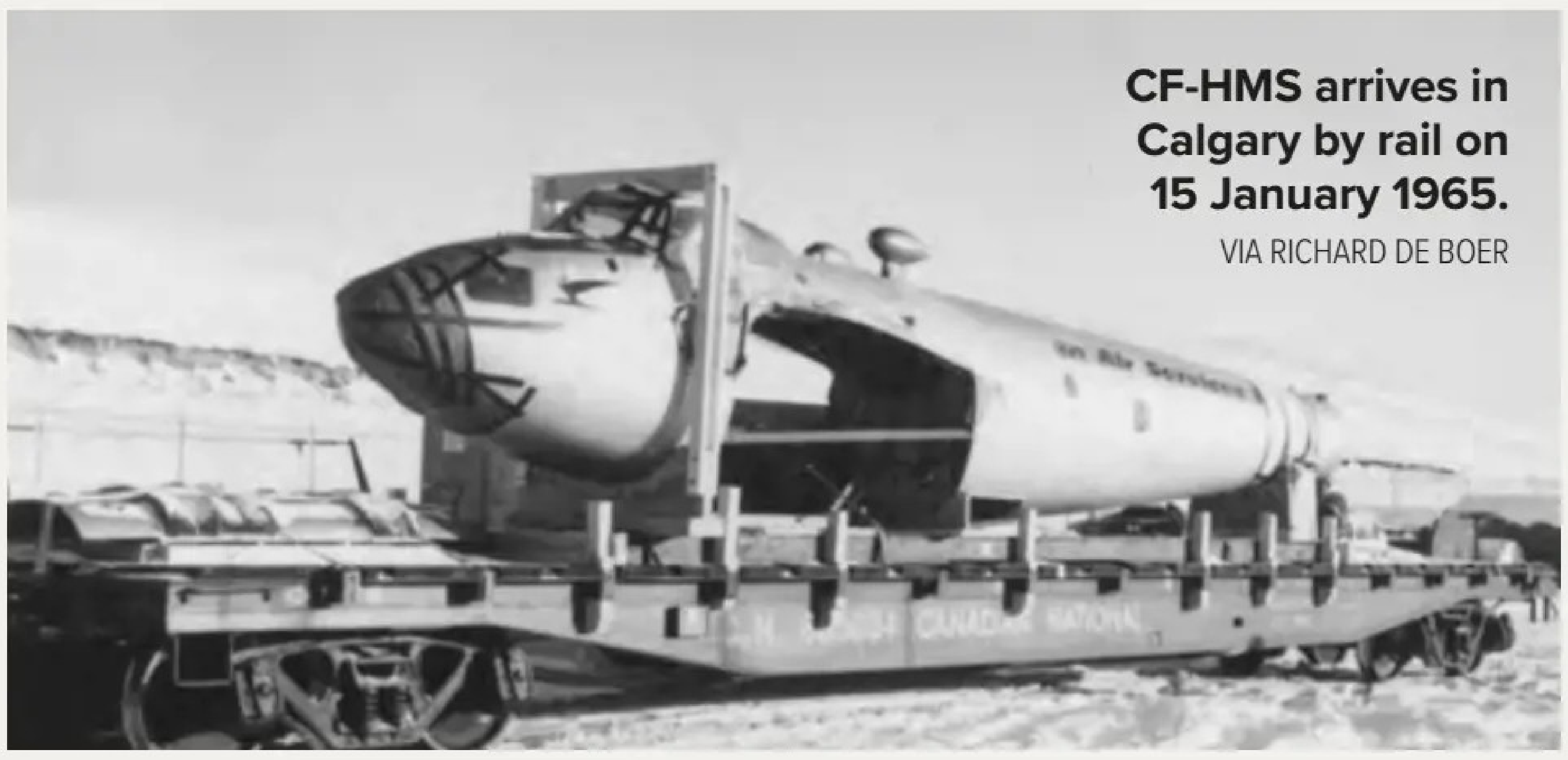
It was back on 15 January 1965 that CF-HMS — which had been operated by aerial survey company Spartan Air Services of Ottawa, Ontario, from 1956-60 — arrived by rail in Alberta's largest city, having been purchased by former No 403 (City of Calgary) Squadron P-51D pilot Lynn Garrison for just $1,100 the previous year. It initially went into open storage at a Shell Canada pipe storage yard. After many moves and much uncertainty as to its future, it was acquired by the City of Calgary during 1973. More turbulent years lay ahead, particularly from 2004-10 when attempts — including one from a British warbird owner — to acquire the Christchurch-built machine from the city put the preservation of its important Canadian civilian operational history in peril, until Calgary City Council voted to retain the machine on Valentine's Day, 14 February 2011. The following August saw the restoration project awarded to the Calgary Mosquito Society.

Commenting on current progress, the founder and president of the Calgary Mosquito Aircraft Society, Richard de Boer says, "The Mosquito is being restored as it served with Spartan Air Services as a photo-mapping aircraft, circa 1958, honouring its actual history and as such will be the only civilian version of the Mosquito of the 35 surviving examples.

"The cockpit instrument panels and controls present numerous challenges as Spartan Air Services modified and repaired their airplanes with British, Canadian and American instruments and components and did not always document changes and repairs. Nor were the changes and repairs consistent from airplane to airplane. Two major elements were missing from the cockpit: rudder pedals and the throttle quadrant, both of which we managed to acquire, but at considerable cost.

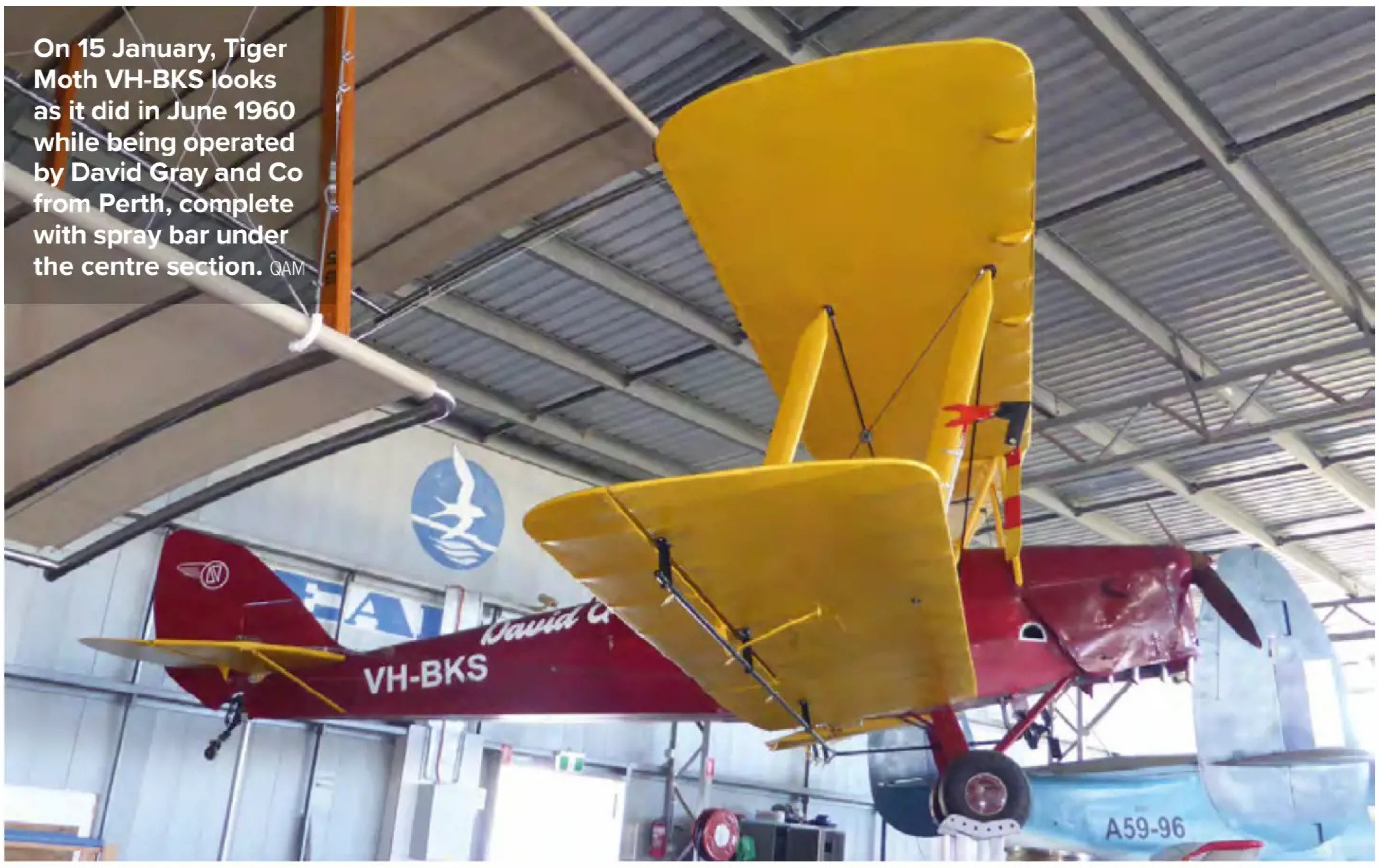
"The wing is currently held securely in a steel jig as we repair and restore it. The entire structure was stripped of all systems, then paint-stripped by hand. We have just recently repainted the fuel tank and undercarriage bays in advance of replacing the electrical and mechanical components. Both the leading and trailing edges of the wing will require extensive repairs.

"All of the structural repair and restoration work is completed on the fuselage, with the interior having been paint-stripped and systems currently being reinstalled. The horizontal stabiliser is also fully restored and awaiting reinstallation. Our mandate is to bring the Mosquito to run and taxi status, and as we get closer to completing the project we will send both of the Rolls-Royce Merlin 113 engines to Vintage V-12s at Tehachapi, California for overhaul."



CF-HMS arrives in Calgary by rail on 15 January 1965. VIA RICHARD DE BOER

SPRAYERS IN THE SPOTLIGHT AT QAM


On 15 January, Tiger Moth VH-BKS looks as it did in June 1960 while being operated by David Gray and Co from Perth, complete with spray bar under the centre section. QAM

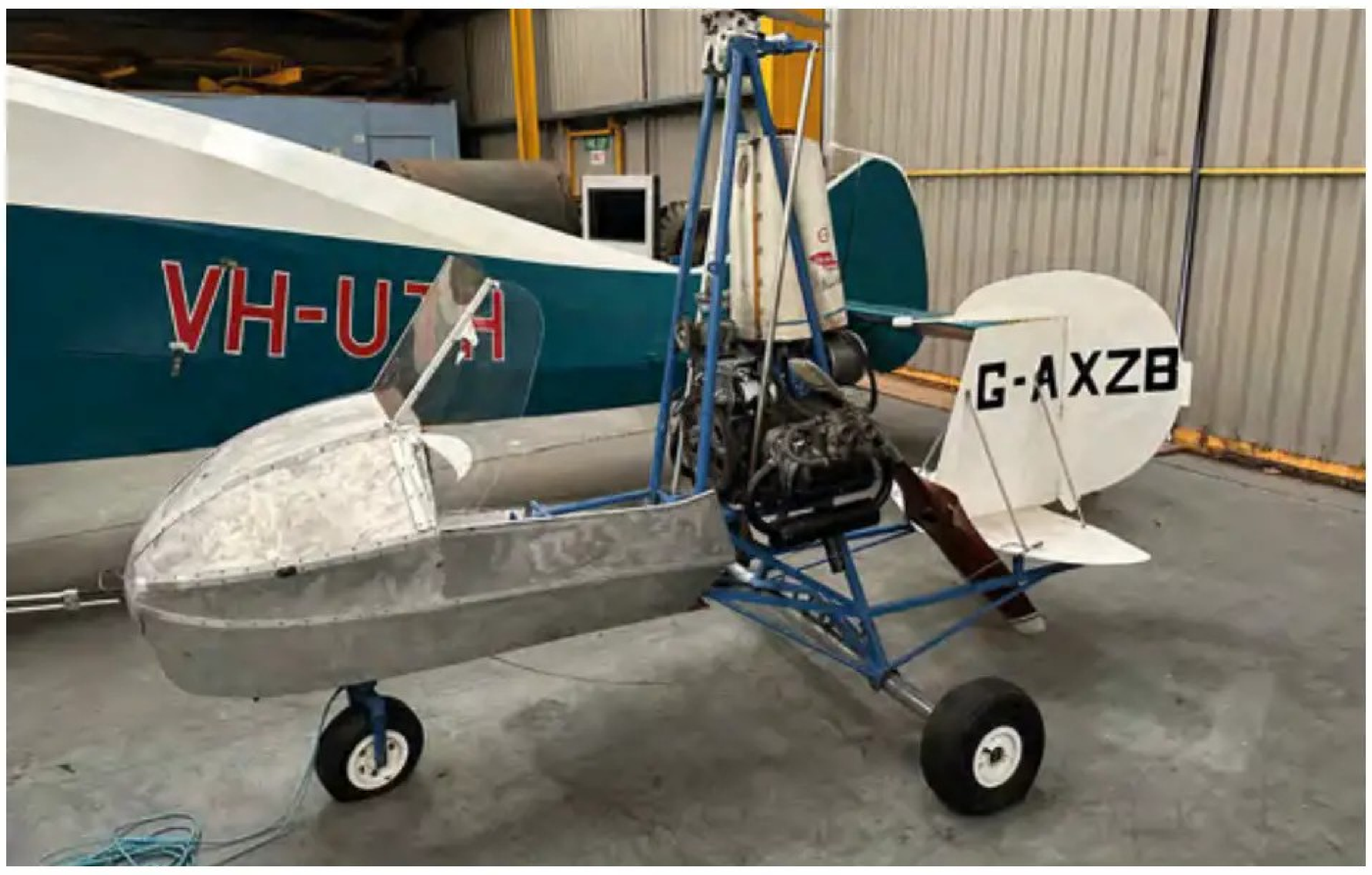
At Caloundra, on the Queensland coast, the Queensland Air Museum had a busy time of it during December, with its de Havilland DH82A Tiger Moth going on display on the 17th in spraying configuration following completion of its restoration, the fitting of wings to a Piper Pawnee — the type that replaced the Tiger on agricultural work — and the arrival of a former Royal Flying Doctor Service Beechcraft 65 Queen Air.

The Tiger, VH-BKS, was built at Hatfield during 1940, being allocated RAF serial R5259 before being shipped to Australia under the Empire Air Training Scheme. Displayed in a silver training scheme in the museum between 2005 and 2017, it has now been restored in the markings it wore while flying on agricultural work with David Gray and Co from Perth during June 1960, towards the end of its six-year career with the company.

On 28 December, Piper Pawnee ZK-CEL had its newly restored wings attached. Originally imported to New Zealand from the USA in 1964, ZK-CEL was donated to the museum by previous owner Greg Ackman through the Australian government's Cultural Gifts Program.

Beech 65 Queen Air VH-FDV — one of only five straight-tail examples of the type imported to Australia — has also now been moved from the grounds of Caloundra airport to the museum. First operated by the Royal Flying Doctor Service (Victorian Section) during the mid-1960s, VH-FDV was named *H. V. McKay* after the Victoria-born and bred industrialist who invented the Sunshine Harvester, in essence the first combine harvester. The Queen Air will be restored to ground running status and painted in its original RFDS markings.

GYROCOPTERS HEADING HOME TO NI


Ekin Airbuggy G-AXZB, its nacelle resembling a post-war drop tank-derived racing special, is off to the Ulster Aviation Society. HOWARD HEELEY

In the spring of 2024 the trustees of the Newark Air Museum at Winthorpe agreed to provide a home to a rare collection of gyrocopter airframe structures, engines, parts and assorted spares, from Stockport in north-west England. Following actions by the museum trustees and its volunteers, seven sets of parts were saved and transported to Newark for safekeeping at the museum's site in eastern Nottinghamshire. During February and March two of these gyrocopters will be leaving for a new home in Northern Ireland. A semi-complete Ekin Airbuggy, G-AXZB, and a collection of dismantled parts for a second Airbuggy, G-AXYZ, are being transferred to the Ulster Aviation Society Heritage Collection at Long Kesh.

Museum trustee Christopher Rice has co-ordinated the process of cataloguing the gyrocopters from the estate of the late gyrocopter collector Roger Light. Christopher says, "After we collected the items last spring, it has been a long process to sort out a multitude of components and to allocate them to the correct airframe. Ekin Airbuggies were built by the W. H. Ekin (Engineering) Company in Northern Ireland, and were a development of the McCandless M-4 gyroplane design. It is appropriate that these two gyrocopters will now be displayed in Northern Ireland, close to where they were originally designed and built."

W. H. Ekin was originally set up during 1969 to manufacturer six M-4s under licence. The improved Airbuggy design first flew on 1 February 1973, power coming from a Volkswagen flat-four, developing 75hp.

A Campbell-Bensen B8M gyrocopter, G-ASNY, was bequeathed to the NAM and another gyrocopter from the collection — the type is still to be decided — will also be displayed there. Other airframes recovered from Stockport are in store at Newark and remain available for disposal to other suitable aviation collections across the UK.

WORKSHOP

ALL A-QUIVER

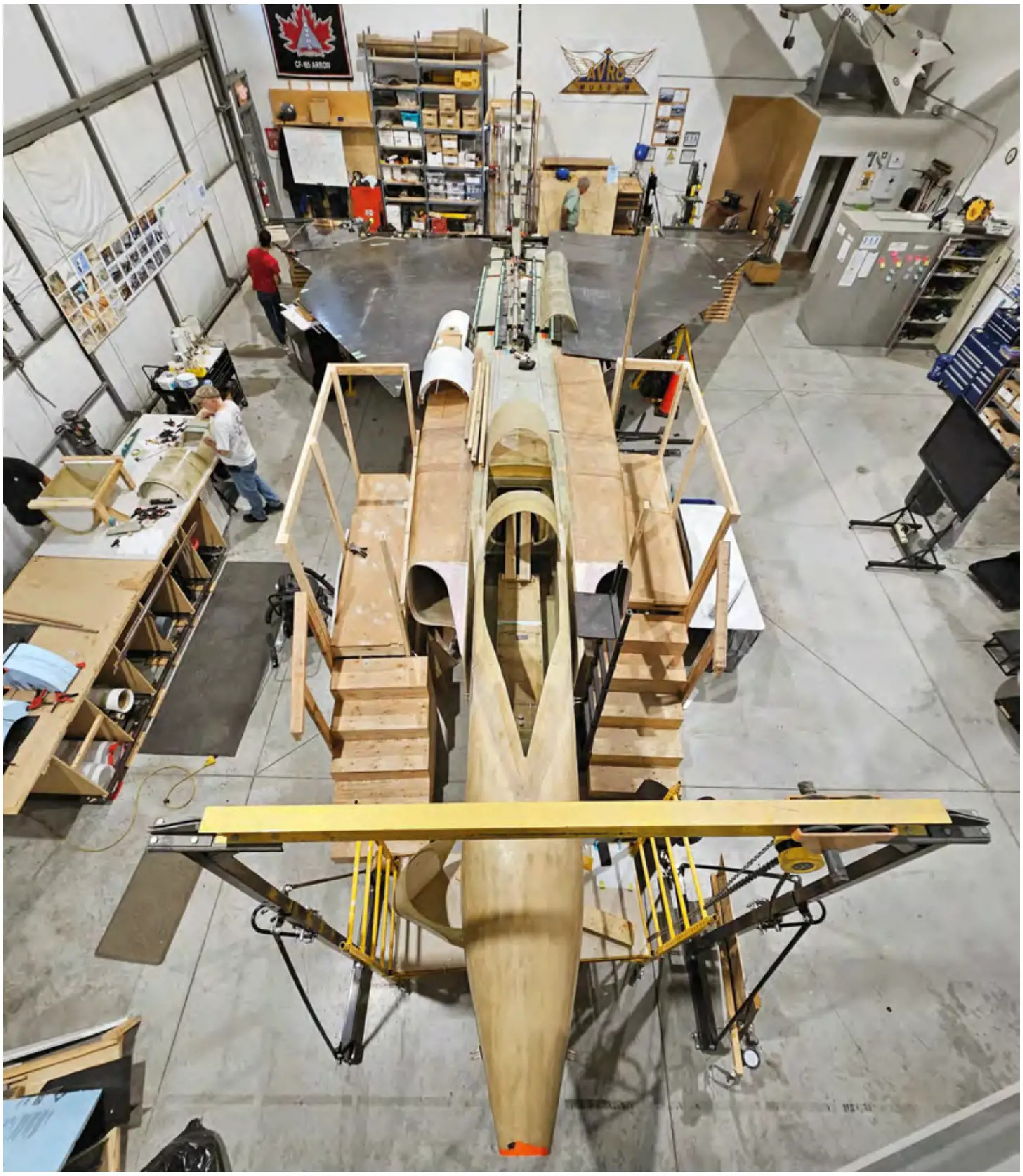
While two full-size static replicas help keep the memory of the Avro Canada CF-105 Arrow alive, the project under way to build a 60 per cent-scale flying example is something else **WORDS AND PHOTOGRAPHY: CHRIS GIBSON**

No answer. Knocked again. Still no answer. It's a Tuesday evening on a deserted industrial estate next to Springbank Airport, north-west of Calgary in Alberta, Canada. This is the only unit with cars parked outside, so it must be the right place, and there is a sign on the door that says Avro Museum. I've come all this way so I might as well try the door.

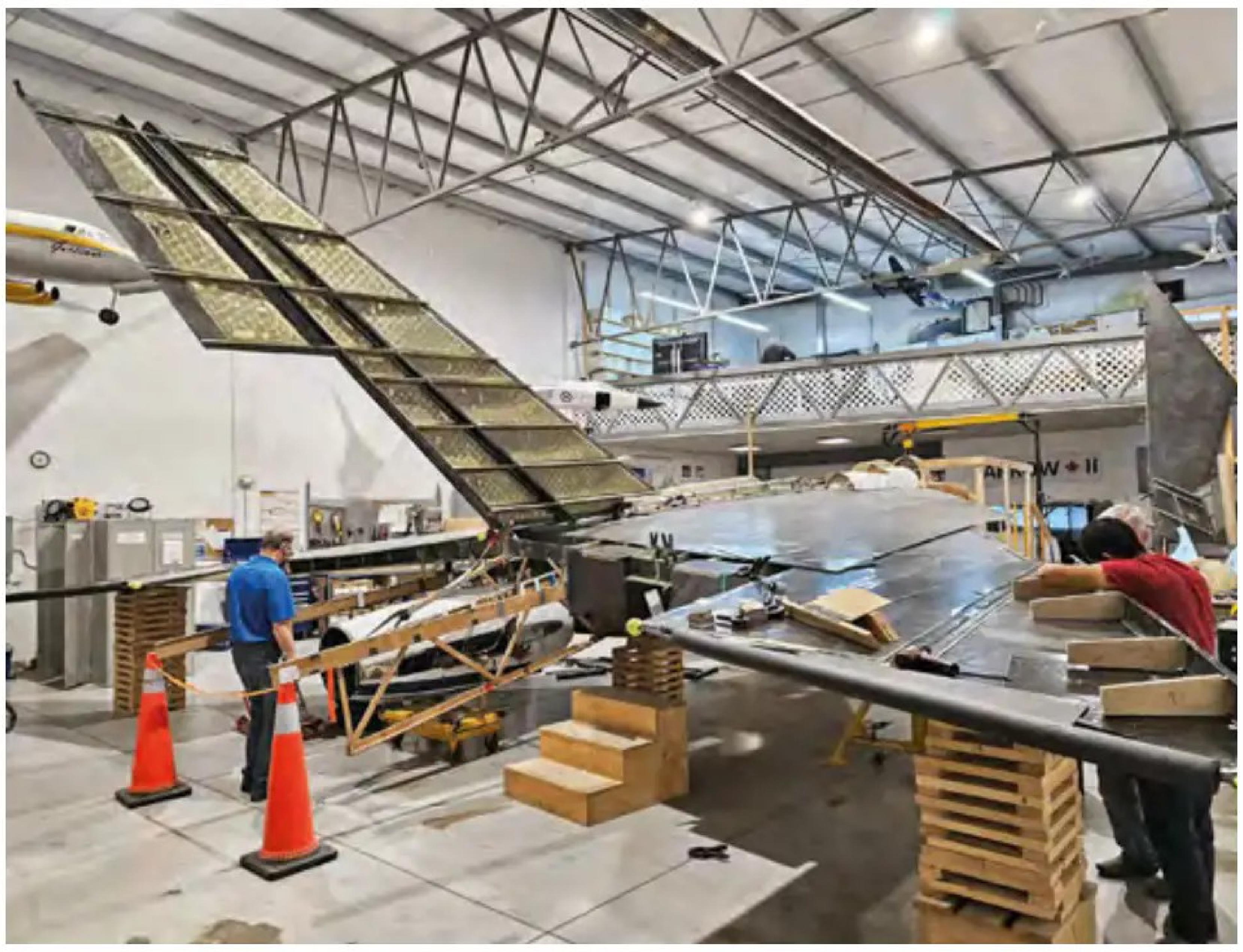
It's unlocked, and as I gingerly push it open I'm met with that glorious aroma of freshly cut timber typical of a woodworking shop. The interior is a hive of activity, with people toiling away at benches, and before me lies the object of my visit: the Avro Arrow II, a 60 per cent-scale, two-seat flying replica of one of the most spectacular aircraft ever to emerge from a Cold War design office, the Avro Canada CF-105 Arrow.

Coralee Hilton outlined the organisation and its aims. It dates to April 1997 and boasts around 400 members, all of whom provide sponsorship for the Arrow II project. The build team comprises a core of 40 people with others helping when they can, and all of them bring their own particular skills. Tuesday evenings are 'build nights', and on the second Sunday of each month the group holds an open house for visitors to view progress.

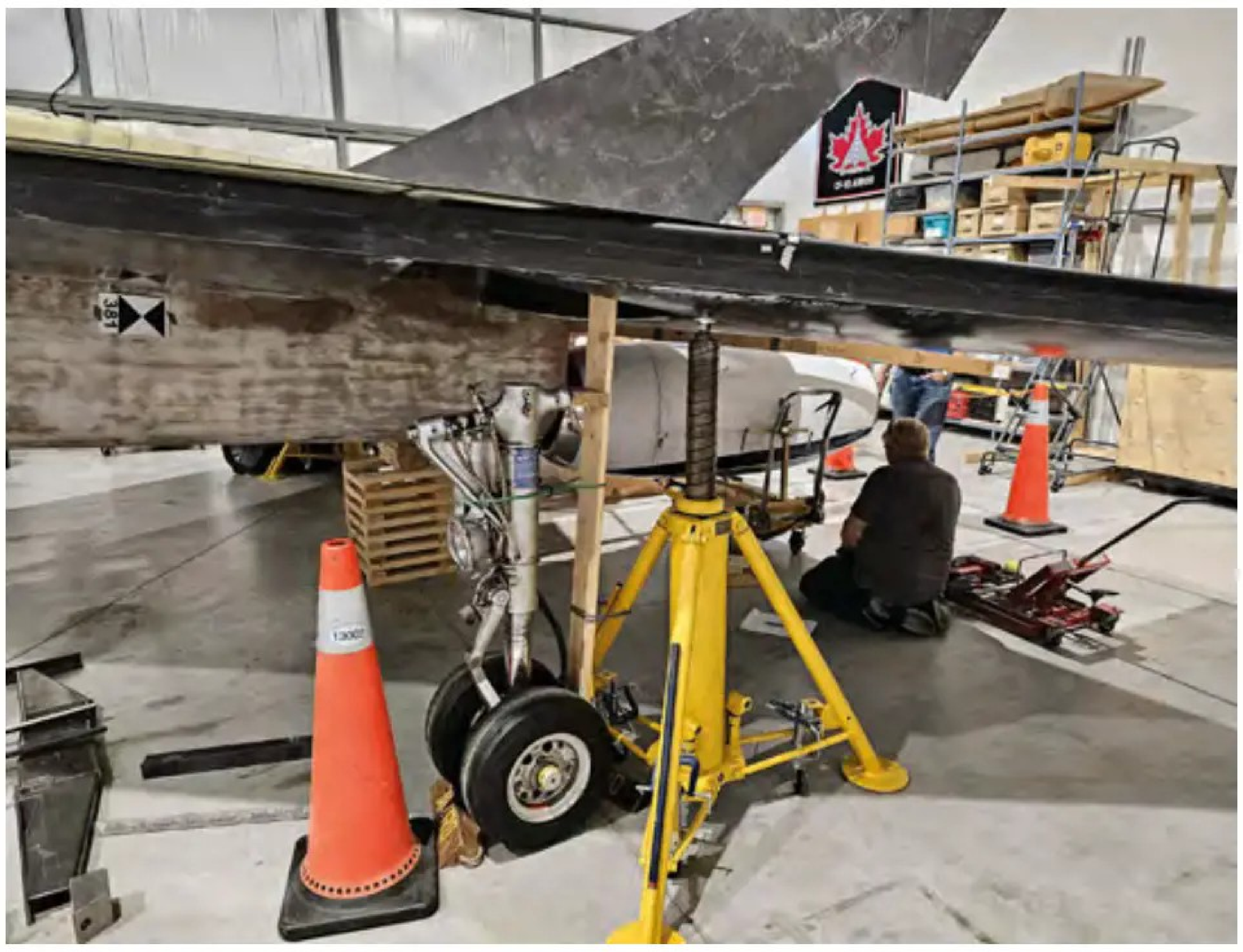
Construction is in wood and fibreglass, with carbon fibre used for the wings and other critical structural areas. The Arrow II is classed as an



Carbon fibre has been used for the Arrow II's wing skins, plywood for the main structure and glass-reinforced plastic for the skins that give the 60 per cent-scale aircraft its form.



The size of the Arrow II's tail fin can be gauged from the people working on the aeroplane. Tennis balls and pipe insulation protect the delicate trailing edge.



The Learjet undercarriage legs will need to be modified to extend their length, and converting the twin wheels to tandem is still being discussed.

experimental aircraft and has been designed to meet Transport Canada regulations, which in the experimental class means a maximum weight of under 8,000lb (3,628kg).

The fuselage, intake ducting, cockpit and rear fuselage have a wooden primary structure with fibreglass skinning to provide the form of the original Arrow. The delta wings and tail fin assembly use carbon fibre skins for strength and low mass. The wings incorporate four of the six fuel tanks, also in carbon fibre, with one tank acting as the collector to feed the engines.

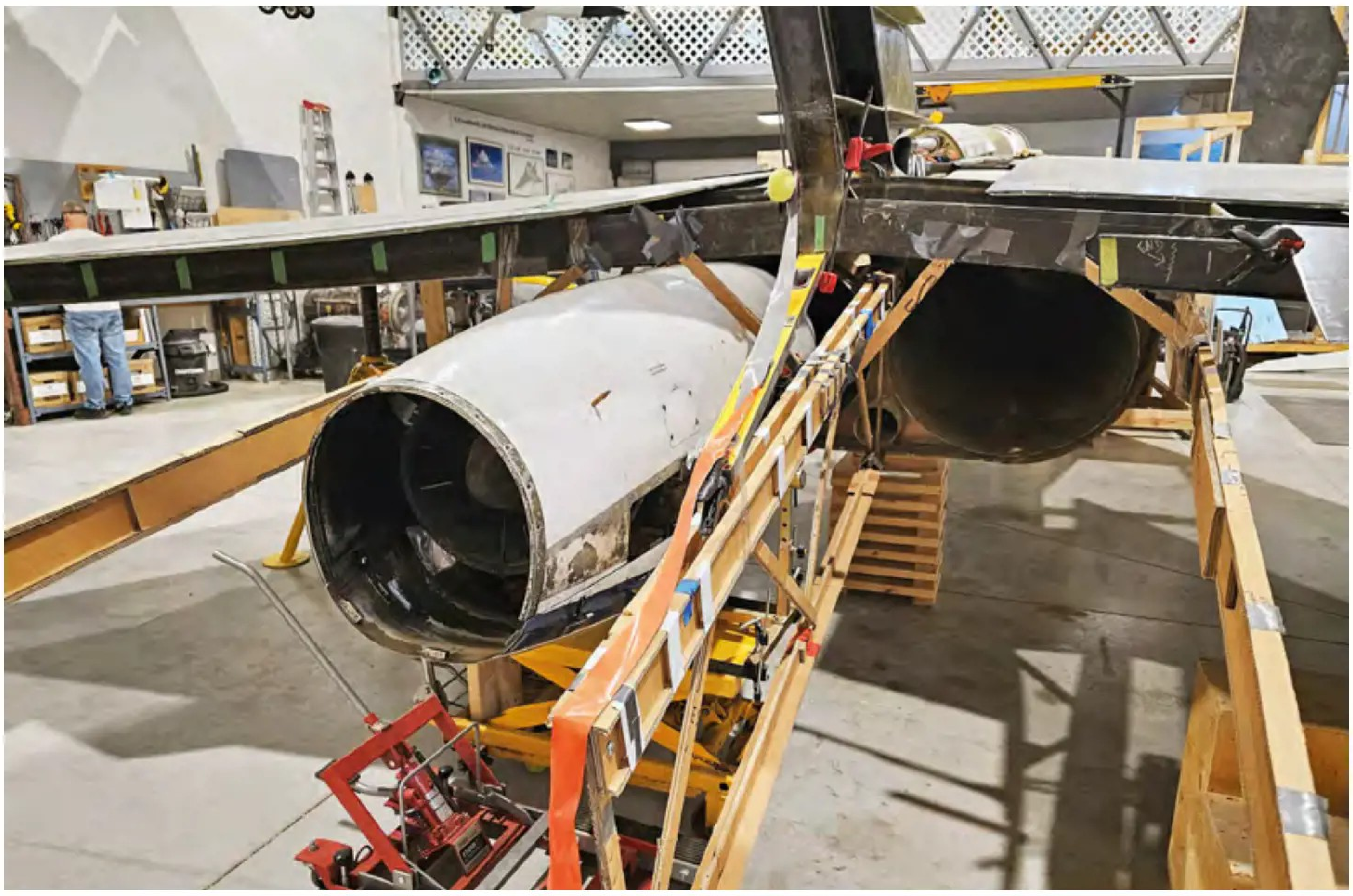
❖

Vince Waller, involved in the power and landing gear aspects of the Arrow II, explained that the engines have an interesting provenance, as they formerly powered a Gates Learjet the museum bought as a donor aircraft and flew into Springbank Airport. The General Electric CJ610s, rated at 2,900lbf, are familiar to many former Canadian Forces engineers as the military version, known as the J85, powers the Canadair CT-114 Tutors still used by the Royal Canadian Air Force as jet trainers.

The powerplants will be installed in the same nacelles they occupied on the Learjet as that implies the auxiliary connections and fuel supply. It also circumvents complications with airflow in the intake ducting as the mass flow would be too high for the CJ610s to handle, causing them to choke. This is avoided by their installation as self-contained in their nacelles, which allows the annulus between the outer skin of the nacelle and the inner skin of the rear fuselage to act as a bypass duct, channelling excess mass flow around the nacelle and out through the rear fuselage. The Arrow II is not intended for supersonic flight, so the intakes and ducting are uncomplicated compared with the original, but they do share the external shape of the CF-105.

One challenge is that the engines are not 'mirrored,' and to reach the access panels in the nacelles to check things such as oil levels on the port nacelle will require an additional access hatch to be cut in the fibreglass skin. These would be in the rear fuselage, which is constructed as a pair of horizontally split clamshells that provide the accurate shape for the Arrow II's engine bay area. The two nacelles are separated by a firewall/ballistic-proof bulkhead fabricated in Kevlar to protect against 'contagious failure' caused by debris, such as engine blades, flying from a failing engine.

Vince also explained that the Learjet may also provide the Arrow II's undercarriage, although this is still up for debate and may lead to one of the aircraft's few deviations, albeit slightly, from the original's



One of the Learjet nacelles, complete with CJ610 turbofan, positioned in what will become the engine bay of the Arrow II. The framework on the centreline is a mock-up of the Kevlar firewall that will separate the engines.

outline. Those familiar with the undercarriages of the Learjet and, more importantly, the CF-105 will notice that one is short with twin mainwheels while the other is tall and stalky with tandem mainwheels. The legs on the Learjet units could be extended, retaining the oleos and anti-lock braking systems and using them 'as is,' but that would require an underwing fairing to accommodate the much deeper twin wheels when retracted. BAC had examined the same thing for the Lightning back in the 1960s and opted for the underwing bulge to house twin wheels. Vince seems determined to have tandem wheels, but practicalities may have the upper hand in this matter.

❖

The control surfaces, such as the split ailerons which were being worked on during my visit, used simple hinges and were electrically actuated, but it may be surprising to discover that the Arrow II has fly-by-wire controls. That, of course, makes absolute sense as fly-by-wire systems are much lighter and do not require control runs or hydraulic piping but, more importantly, the control system can be developed and tested in a computer-based flight simulator.

The simulator has a 60 per cent-scale external shell complete with cockpit framing, but no glazing. A glance inside shows how the Arrow II's cockpit might look, with a computer monitor in the centre displaying the instruments you might expect on a twin-engined aircraft of the 1950s. To the left of the pilot is the throttle

Replica Nacelles

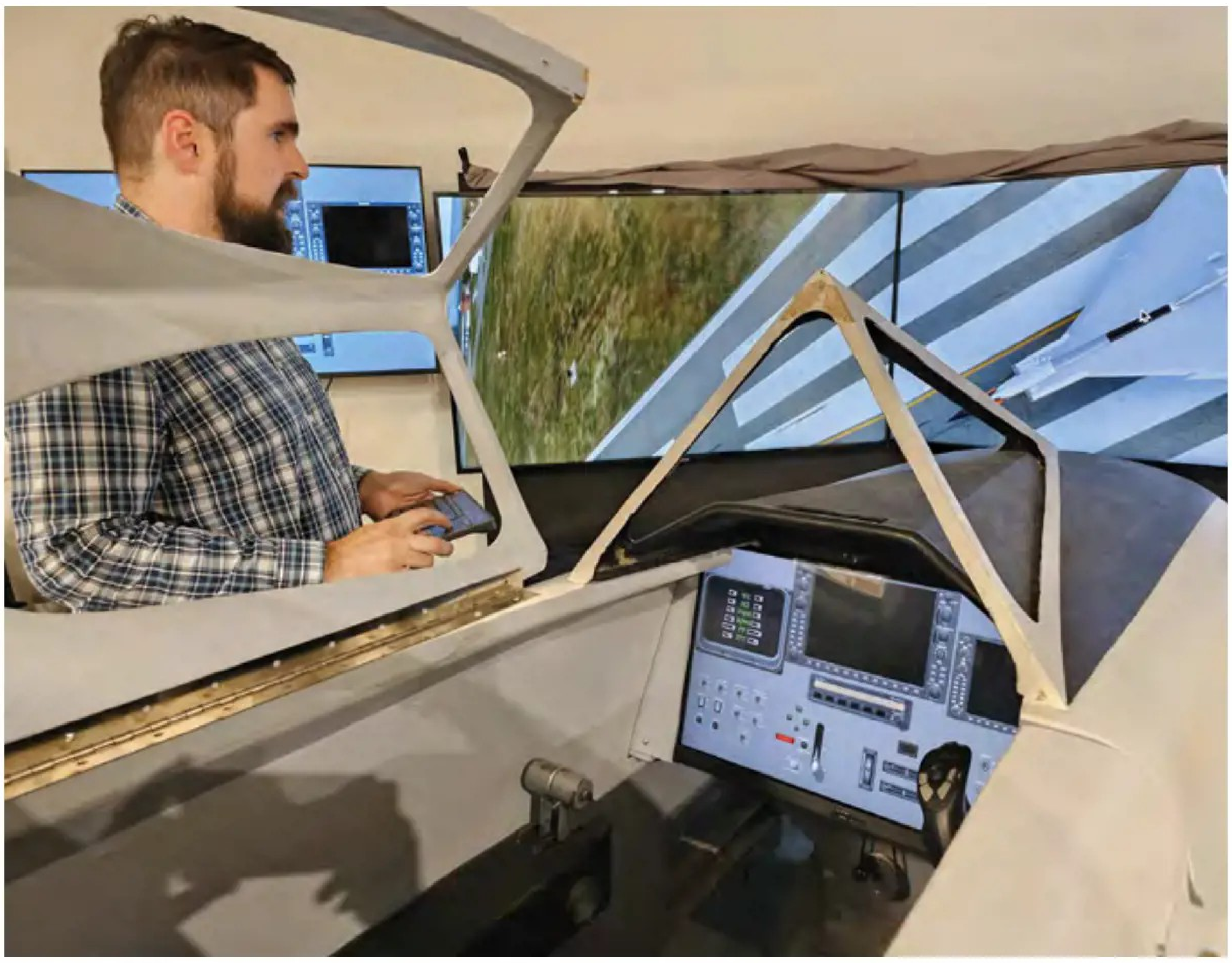
A volunteer makes formers and skins for the Arrow II's turtleback section.

In addition to those involved in construction of the Arrow II, many members are in the process of collecting and digitising Arrow-related material for what is the most comprehensive archive on the CF-105 in the world.

KILLED TOO SOON: THE ORIGINAL ARROW

The CF-105 Arrow was developed to meet Royal Canadian Air Force specification AIR 7-3, issued in April 1953, to develop a replacement for the Avro Canada CF-100 Canuck as the primary interceptor in the RCAF. Its intended role was the destruction of Soviet bombers approaching the main population centres of Canada and the continental United States. The Arrow was to be armed with the AIR-2 Genie, AIM-4 Falcon or AIM-7 Sparrow air-to-air weapons and interceptions were to be controlled by a sophisticated air defence ground environment of radars and control centres. At one point the Arrow was proposed to meet the Royal Air Force's specification F153 as an alternative to the Gloster Thin Wing Javelin, pending delivery of the Fairey Delta III interceptor to meet F155.

Avro's Jim Floyd designed a large two-seat delta powered by two Orenda Iroquois engines. With interim Pratt & Whitney J75 powerplants, Arrow RL-201 took to the air on 25 March 1958, but politics intervened and just under a year later, on 20 February 1959, John Diefenbaker, the Prime Minister of Canada, cancelled the CF-105 and its Iroquois engines. Pretty much everything was scrapped, including the completed airframes and the engines, just a few small items surviving. Not even BAC's TSR2 suffered such destruction. The entire affair has left deep wounds in Canada's aviation industry and society in general.



Greg Mitchell was dealing with the simulator and flight controls during the author's visit. The Arrow II uses fly-by-wire, and visible in the cockpit of the simulator are the cockpit instrumentation in the form of a multi-function display, the throttles on the left and the sidestick controller on the right.

quadrant and to the right a sidestick controller. In front of the simulator is a trio of large monitors that display the world around the aeroplane.

The flight controls and simulator are being developed by a team led by Gregory Mitchell, who explained how the basic simulator is based on a fairground ride. Despite its apparently humble origins, it has been provided with state-of-the-art flight simulator software based on X-Plane and is being continually developed to reflect the real Arrow II. As the control system evolves, pilots — including Steve Rose, manager of flight operations — 'fly' the simulator to establish the flight regime and flight characteristics.

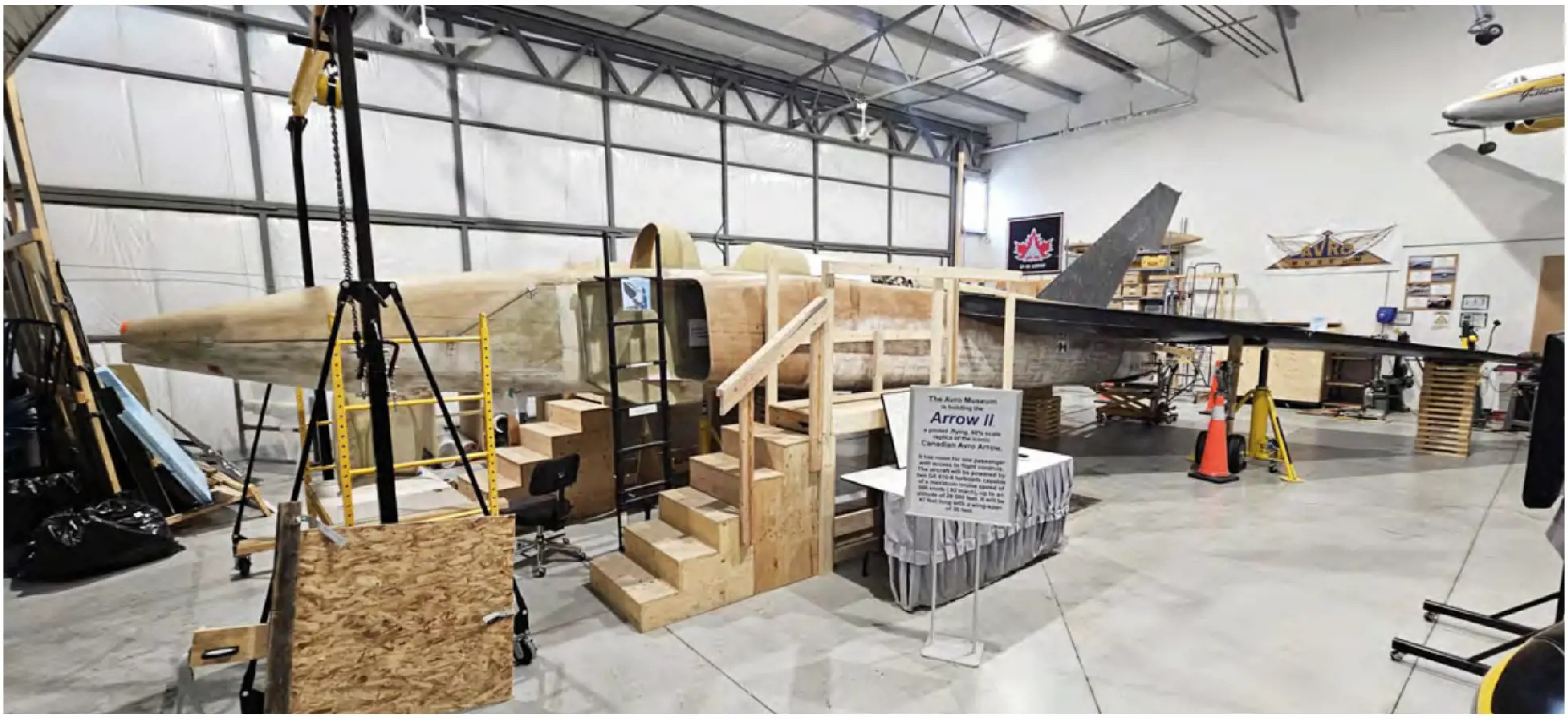
Another team member, who I think should remain anonymous, said he likes to beat up the Springbank tower at Mach 1. As for whether the Arrow II itself would be able to break the sound barrier, that's something for the future, and no doubt the regulators would have an opinion on it.

> *"It may be surprising that the Arrow II uses fly-by-wire controls"*

Why build the Arrow? Canadians, even those not the least bit interested in aviation, know about the CF-105 and its demise in 1959. Don Squires, who is involved in publicity and raising awareness of the project, says his father saw the original Arrow fly and had such pride in this spectacular Canadian achievement, he never stopped talking about it. Don 'caught the bug' and became involved in the Arrow II. He has a trailer full of 'merch' that he takes to airshows and other events around Canada. His recent move west to Calgary of course had nothing to do with the Arrow II. Of course.

Like many of the build personnel, Don is retired, but among the Avro Museum team are a number of youngsters including Sylvan and Keillor, the most junior members. Both are in the Air Cadet League of Canada, usually referred to as the Air Cadets, and Sylvan — who's been part of the effort for two years — thoroughly enjoys being involved. Sylvan hopes it will provide unique experience for a future career in aviation.

The Arrow II really is a fascinating project, established to ensure Canada's aviation heritage lives on, even if it is at 60 per cent scale. One can only admire the sheer audacity of the people who came up with the idea and the determination of those bringing it to life.



The Arrow II, like the original, is massive. The workshop is a splendid facility and the Arrow II testament to the skill of the volunteers.

STEVE SLATER

HangarTalk

A vintage light aircraft aficionado's view on historic aviation

If one area of the historic aircraft scene in the UK has retrenched in the past few decades, it is jet warbirds. The reduction in the variety and volume of British vintage jets is worrying, but unsurprising. The cost of flying even the simplest of them is a factor higher than, say, a Mustang or Spitfire. Now the number and range of such jets has sunk to an all-time low, with just a handful of civilian operators remaining, mainly of training aircraft.

With the RAF restricting its display flying to a handful of types — including, of course, the Red Arrows and the Battle of Britain Memorial Flight — airshow organisers in the UK are left with scant pickings if they want some jet content. In terms of piston-powered warbirds, we are pretty well-served, in particular with Spitfires and other World War Two fighters. Heavier types, too, still have a prominent place thanks to such as the RAF's Lancaster and the privately owned B-17G *Sally B*, although the absence of a Mosquito is a glaring omission. But the most potent jets flying today in civilian hands must be brought to British shows from overseas.

Hunter F58 ZZ190, part of the fleet operated by Leeming-based Hawker Hunter Aviation on defence contract work, takes off from Fairford at the conclusion of RIAT 2024. BEN DUNNELL

Looking back a decade or more, the 'Vulcan factor' was a mixed blessing. On the one hand, XH558 drew in tens of thousands of people who would necessarily have been attracted by an older aeroplane. The combination of size, awesome noise and power, along with nostalgia for when Britain felt it led the world, made the Vulcan a winner. Conversely, it was often said XH558 and its fuel-thirsty Olympus engines hoovered up display budgets that could have helped keep other old aircraft flying.

> ***"Other jets didn't achieve the pull of the Vulcan"***

No matter how illustrious the types were, other jets didn't manage to achieve the same 'pull'. The Canberras that flew in private hands sadly never seemed to attract the interest created by the Vulcan. At one stage, many years back, the former A&AEE Comet 4 *Canopus* could potentially have moved onto the display circuit as a civil aircraft, but a budget simply was not there. All the privately owned airworthy Meteors have now gone. Add in the effect of 2015's Hunter accident at Shoreham, and it's easy to see why so few vintage jets now fly in Britain. The owners of those that are still around must be applauded for their commitment.

I was, perhaps, lucky. I was a keen enthusiast in the 1970s and 1980s and the likes of the Alconbury, Finningley, Leuchars and Upper Heyford open days demonstrated the best on offer from the RAF, the US Air Force and NATO air arms. How about a stream take-off by a squadron of Lightnings? The involvement of Phantoms from the US, German and British services? Or a touch-and-go from an F-104 combined with a mid-runway barrel roll? They all happened in front of my Instamatic. In fact, my logbooks recorded Starfighters being displayed by the Canadian Forces, the German air force and navy, as well as Danish and Dutch examples. And that's before we get on to more esoteric types such as the OV-10 Bronco, S-2 Tracker or KC-97.

The Air Tattoo, first at Greenham Common and then at Fairford, brought such aeroplanes together in larger numbers than anywhere else. Thankfully, today's Royal International Air Tattoo continues that tradition — and even with some of the same types. Phantoms, Hunters and a turboprop Tracker fire-bomber have all graced Fairford in recent seasons, bringing with them strong pangs of nostalgia for those far-off days. Despite all the new hardware also on show, there's still a place for the veterans.

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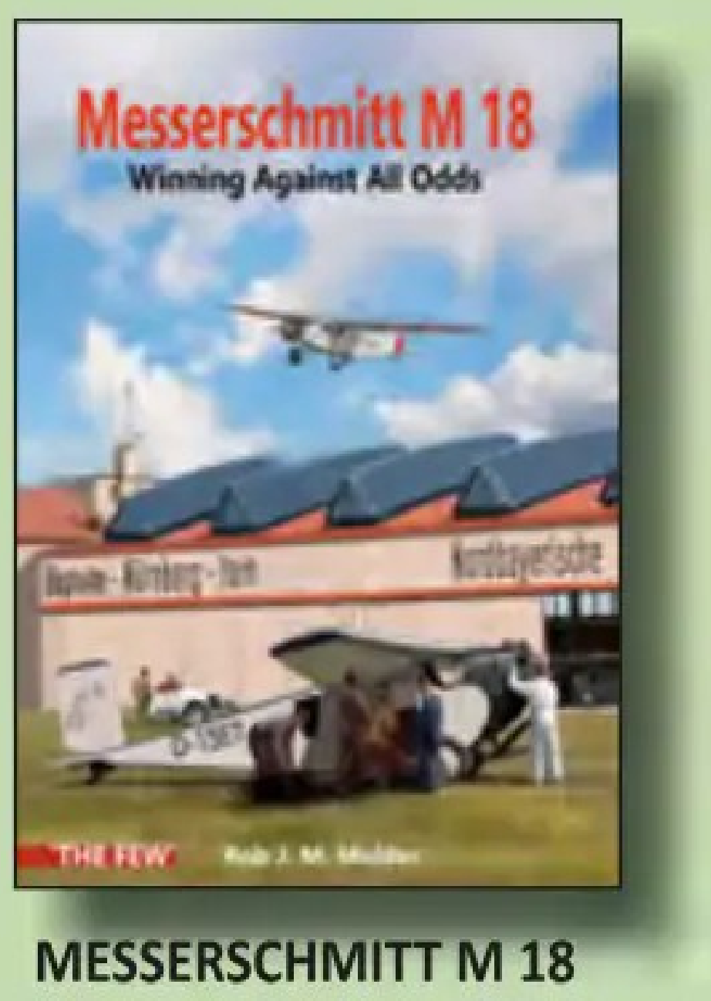

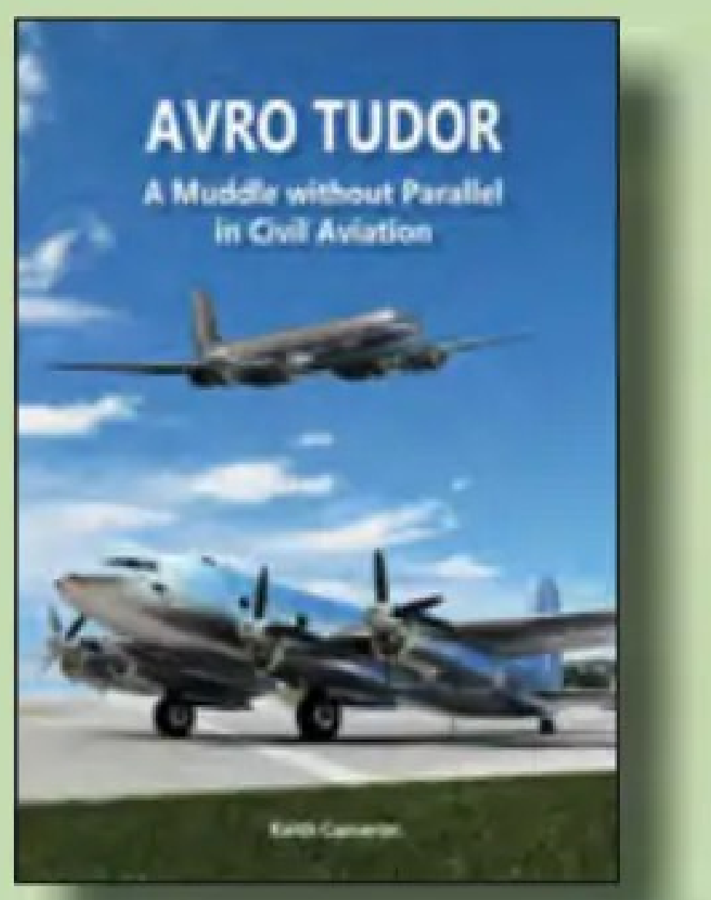

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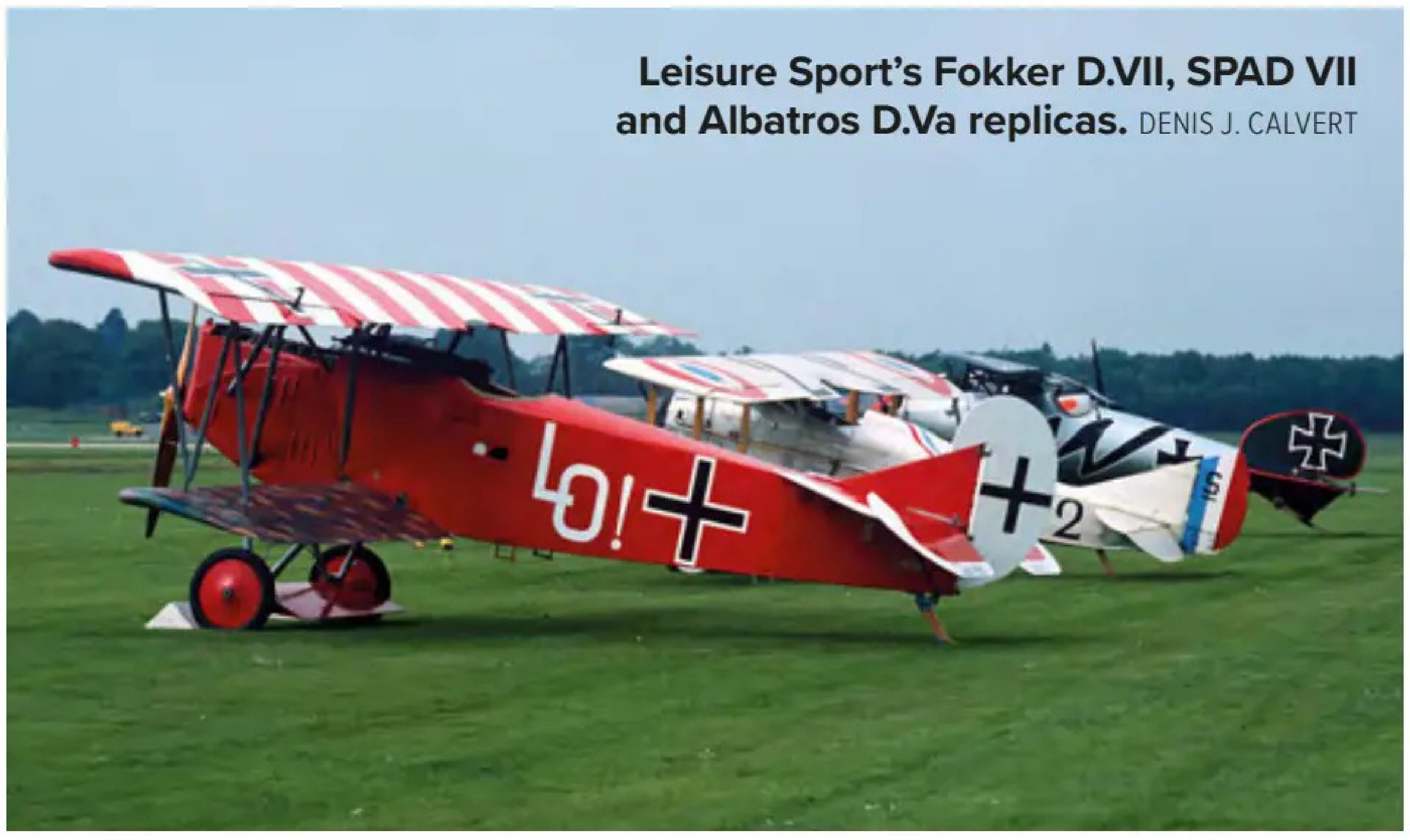
DENIS J. CALVERT

FlightLine

Recollections and reflections — a seasoned reporter's take on aviation history

The location now occupied by Thorpe Park, billed as "The UK's most thrilling theme park", was once a gravel pit just off the A320, half-way between Chertsey and Staines. Its owners, Ready Mixed Concrete, got planning permission in 1970 for a change of use — a dramatic change of use — to a water park leisure attraction. The site was to be redeveloped and partly flooded, subsidiary company Leisure Sport being established to promote the new operation, whose concept was a far cry from that of today's Thorpe Park.

Initially promoted as "The History of the British People as a Maritime Nation", Thorpe Park was officially opened by Lord Mountbatten on 24 May 1979. Rides there were, but nothing of the white-knuckle variety today's theme park connoisseurs demand, and many of its attractions had a distinctly educational purpose. 'Model World' offered a park with bite-sized 1:36 reproductions of the world's most famous buildings, including the Eiffel Tower — the original Gallic symbol — and its British equivalent Nelson's column. "But what", I hear you cry, "has all this to do with aviation?" Well, quite a bit.



Leisure Sport's Fokker D.VII, SPAD VII and Albatros D.Va replicas. DENIS J. CALVERT

Three 'maritime nation' exhibits at Thorpe Park paid homage to the Royal Naval Air Service, the Fleet Air Arm and the Schneider Trophy contest. In advance of the site's opening, Leisure Sport purchased or ordered the construction of a goodly number of replica aircraft, both static and flying, to be displayed around the park. Pride of place among several seaplanes was taken by the replica Supermarine S6B 'S1595', which was normally exhibited on the lake. When afloat, it sat a bit high in the water, no doubt because of its lightweight construction and the lack of a Rolls-Royce 'R' V12 engine, but it looked every bit the part.

> *"Leisure Sport purchased or had constructed several replicas"*

Again a replica but very much a flying one was S5 'N220'/G-BDFF, which was sometimes flown from Thorpe Park despite the site's close proximity to Heathrow. It was frequently seen at airshows including Farnborough 1976, the 1979 Greenham Common IAT and, memorably, the 12-13 September 1981 celebration at Calshot of the 50th anniversary of Britain's outright Schneider Trophy win. The aircraft came to grief displaying at Thorpe Park on 23 September 1982 as a result of fuel starvation, and suffered a major break-up on cartwheeling during a forced landing on water. It later passed into other hands and was rebuilt to fly again. Further Schneider Trophy replicas to be seen included the Deperdussin that won the first race in 1913, Curtiss R3C-2 (1925 winner) and Macchi M39 (1926 winner).

Leisure Sport also assembled a fleet of World War One aircraft types, most of which were airworthy 'flyers'. Viv Bellamy was responsible for the construction of reproductions of an Airco DH2, Fokker Dr.I and two Sopwiths, a Camel and 1½ Strutter. Contemporary replica German scouts in the shape of an Albatros D.Va and a glorious, black-and-yellow checkerboarded Fokker D.VIII were built, appropriately, in Germany. Given that there was no more than a rudimentary grass strip at Thorpe Park, these types were based at White Waltham. Together the pilots worked up a display routine that included formation flying, solos and a bit of aerial combat and gave their first, high-visibility public show at White Waltham's Air Pageant on 14-15 May 1977 in the presence of an air-minded Prince Charles.

The fatal crash of the D.VIII at White Waltham on 21 August 1981 led, directly or indirectly, to a slowdown in Leisure Sport's aerial activity. This was at a time when the owners were anyway having a rethink of Thorpe Park's attractions, in which Britain's maritime past would feature less prominently — if at all — and, as a result, the aircraft collection would be sold off and dispersed. But wasn't it great while it lasted!

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From the Cockpit

RICHARD CROCKETT

Join one of Shuttleworth's newest pilots on his vintage flying journey

The Chipmunk is often referred to as the 'poor man's Spitfire', but this description could only apply after 1946, when the DHC-1 first took to the skies. This raises the question: which aircraft might have earned such a title in the 10 years between the Spitfire's first flight and the Chipmunk's development? Some might suggest the Tiger Moth as a candidate, but I consider the Miles M14 Magister to be a better one.

So, why the Magister? For starters, the timelines align quite closely, with the Spitfire making its first flight around a year earlier. Beyond this, I would argue the Magister shares far more characteristics with the Spitfire than the Tiger Moth does.

The Magister is, of course, a low-wing monoplane trainer with two tandem seats, derived from the Miles Hawk Trainer to meet an Air Ministry requirement. In terms of external appearance, it was largely unchanged from its predecessor. Its principal variations include an enlarged cockpit designed to accommodate parachutes for both pilots, a blind flying hood that can enclose the rear cockpit, and anti-spin strakes at the rear of the fuselage to enhance safety in basic aerobatic practice.

Richard often flies the Magister operated by David Bramwell, and took it to the Abingdon show in 2023. BEN DUNNELL

Chiefly constructed from wood, the Magister boasts a notably streamlined silhouette, especially when compared with the fabric-covered biplanes of its era — such as the Tiger — and incorporates various 'mod-cons', including a tailwheel in place of a skid, wheel fairings, brakes and pneumatic flaps.

> ***"The 'Maggie' is much simpler to fly in many respects than the Tiger"***

Access to the cockpit is gained through a door on the right-hand side of the fuselage, and once inside there is ample space. The instrument panel is relatively basic, reflecting the standard RAF trainer arrangement of the time and featuring typical blind flying instruments. Beneath the panel on the right-hand side is the fuel selector for the wing tanks; on the left are the flap selector, wheel brake lever, throttle and mixture controls.

Starting the Gipsy Major engine is undertaken in the traditional way by hand-swinging, and once it is running you can begin taxiing to the runway. Taxiing can sometimes be challenging due to the Magister's fully castoring tailwheel and rudimentary brakes, which may leave one appearing slightly inebriated as you gauge just how much brake to apply when steering in the intended direction.

Unusually, the Magister may be flown solo from either seat. The forward seat offers an excellent, nearly unobstructed view over the nose, while the rear position, though inevitably more restricted, still provides a surprisingly good outlook thanks to the low monoplane wing — especially when compared to biplanes.

In flight, the Magister is really quite straightforward to handle. It outperforms the Tiger, cruising at around 125mph. However, at higher speeds the ailerons do feel heavier, and when flying extended displays or formations, one can soon find one's arm getting rather weary! Landing is relatively simple thanks to the powerful flaps, though you must take care not to exceed the somewhat low flap limiting speed, or the flaps will blow back up.

Overall, the 'Maggie' is a pleasure to fly — much simpler in many respects than the Tiger, which some purists insist makes it a poorer trainer. In my view, however, it was precisely the Magister's added complexities that better prepared pilots for the next step up to the Harvard and ultimately on to fighters. So, a pre-Chipmunk poor man's Spitfire? Perhaps. It certainly gets my vote.

Please help preserve the future of the RAF Coltishall Heritage Centre

Photo credit: Rene Vink

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In every issue, the writer of our Letter of the Month wins a **£25 book voucher** to spend with leading military and transport publisher Crécy.

LETTER of the MONTH

Fifty years ago I lived in a cottage in the coastal village of Little Haven, Pembrokeshire. The village boasted three pubs and The Swan, overlooking the beach, became my local. During my stay there it changed hands and the new landlord was George Nelson-Edwards. As a regular I got to know him quite well and invited him to write in my 'book'. This was a Gloucestershire Education Committee exercise book I had kept since my school days, where I asked veterans of the Second World War to write responses to my questions. George's written answers were an astonishing record of the experiences of a Battle of Britain fighter pilot.

I wrote out 10 questions that covered his training, knowledge, experiences, attitudes and opinions during the Battle of Britain and after, the aeroplanes and theatres he flew in. Regarding the critical situation of the summer of 1940: "I don't think I was conscious, at any rate in the beginning, of any *critical* situation in Fighter Command… if I gave it any thought at all it was to leave all the worrying to those who were paid for it. We just had to get on with it and face the situation as it presented itself. Our official briefings mostly emphasised the vital importance of achieving maximum interceptions and interference with German bombing forces, and making full use of the tactical advantages afforded by our early warning and control systems, i.e. don't stooge around and be shot down by the Hun for no reason at all! Unofficially talk of collapse and capitulation was mostly ignored and although we inwardly knew we were face-to-face with defeat, it was impossible to believe that it could happen to us, despite the fact that it had just happened to the French before our very eyes… I always felt that the possibility of invasion was very real. I was not demoralised but frequently bemoaned the fact that we seemed to be outnumbered."

In 1938-39 he was an undergraduate member of Oxford University Air Squadron and an acting pilot officer in the RAF Volunteer Reserve. He gained his wings at Cranwell after training on Hawker Harts and Hinds and was posted in May 1940 to No 6 OTU at Sutton Bridge, Norfolk for conversion to Hurricanes. The course lasted only four weeks and the instructors were "hardened fighter pilots fresh from France, with many kills to their credit". They learned how to attack a bomber from astern, the quarter and even semi-frontal and vertical. He wrote, "It was all too short, and later in actual combat situations varied so much we just learnt the hard way, although I must admit that the theoretical training at Sutton Bridge must have created some sort of practical foundation in the subconscious."

During the Battle of Britain, George Nelson-Edwards was a pilot officer with No 79 Squadron on Hurricanes and was mentioned in despatches. He served at Acklington, Biggin Hill, Pembrey and Fairwood Common. His attitude to the enemy: "I think I felt hostility towards all Germans, Nazis or not, but knowing my job was to shoot down bombers I developed a particular dread and hatred towards them and the crews who flew them. On the other hand, in some odd way my attitude towards the Luftwaffe fighter pilots bordered on healthy respect if not fellow feeling."

After the Battle of Britain, "our role was changed to convoy escort and patrol by day and attempts at bomber interception at night. Ground control was hopelessly inadequate for single-engine single-seat fighters operating against enemy night raids."

His worst moment as a fighter pilot: "The moment I realised I had made a fantastically stupid mistake… I was caught in the crossfire of nine He 111s, at 20,000ft about 50 miles out to sea. I first spotted them when they were tiny random black spots. With some height advantage I closed in very rapidly and picked on a Heinkel which turned out to be the middle aircraft of the formation. The other Heinkels closed into a tight formation on either side and I was a sitting duck. My Hurricane was ripped to pieces. How I survived I shall never know but I found I could still control the aircraft in a glide… I bailed out, [and] went down to about 2,000ft over the sea after spotting a column of smoke rising straight up through the evening haze. It was a lone merchant ship, SS *Dartford*, and I was eventually fished out by men from their lifeboat. It was three days before I saw land again and my wife received the dreaded telegram — 'Missing, believed killed in action'. I never made quite such a bad mistake again!" In conversation afterwards he added that this event had occurred over the Bristol Channel and that the water was freezing.

George Nelson-Edwards alongside a No 79 Squadron Hurricane during 1940.

His Spitfire and Hurricane comparison: "Whilst the eight Brownings of the Hurricane gave a fair chance of inflicting damage even with inaccurate flying, the Spitfire flown with accuracy and cool precision gave more than a fair chance of a kill… in other words the Spitfire was not so good in the hands of an inexperienced pilot."

Other theatres compared with the Battle of Britain: "I led No 93 (Spitfire) Squadron on Operation 'Torch' — the invasion of French North Africa — from Algiers to the fall of Tunis. We had a very rough time and on the whole I would say that the intensity was greater than during the Battle of Britain. The Luftwaffe fighter force was far superior in numbers and our combats were 90 per cent fighter-v-fighter and 10 per cent fighter-v-bomber, whereas in the Battle of Britain the converse was the case. Despite all this, however, the summer of 1940 was indubitably a unique experience for me!"

After the campaign in North Africa, George Nelson-Edwards was awarded the Distinguished Flying Cross and led No 231 Squadron flying low-level photographic reconnaissances over Normandy. He was acting wing commander for fighter operations over the Normandy beach-head, France, Belgium, Luxembourg and Germany and was mentioned in despatches. After the war he held a number of senior ranks and wrote the original operational requirement for the Harrier, before retiring with the substantive rank of wing commander in 1961.

I was delighted with his writings in my 'book' and enjoyed discussing Second World War aircraft with him. His wife discreetly and quietly requested that I avoid the Normandy campaign in conversation. His role was ground attack and he still had nightmares about it.

Dr Glenn Fisher

Regarding Lars-Erik Ingerlo's letter in the January 2025 issue, regarding the Junkers Ju 86 K (Flygvapnet designation 3C-2) used for firefighting practice at Kungsängen airport, the wreck was still present on 10 May 1970. With this letter is a picture, taken by Benny Karlsson, on that day.

The Ju 86 K most likely lingered on until the early 1970s, when it was scrapped. Part of the tail section went to Aerospace Expo at Arlanda airport, but was never put on public display. In 2002, Aerospace Expo was liquidated, eventually being re-formed as Arlanda Flygsamlingar. The Ju 86 K parts eventually found their way to Gilleleje in Denmark, where a Luftwaffe exhibition, centred around a full-scale replica Messerschmitt Bf 110 G, can be found. The Junkers was Werknummer 0860373, being delivered to the Flygvapnet on 26 April 1938. Struck off charge on 12 April 1956, the aircraft was allocated for firefighting practice, a fate shared by many other redundant Flygvapnet Ju 86 Ks.

As for the Wirraway mentioned on page 138 as having been sent to Sweden, it was most likely serial A20-233. It arrived in Sweden on 13 October 1981 from the Warbirds Aviation Museum at Mildura, Victoria, having been exchanged for Harvard IIb (Sk 16A) serial 16077. The parts not used in the reconstruction of the NA-16-4M (Sk 14) were returned to Australia.

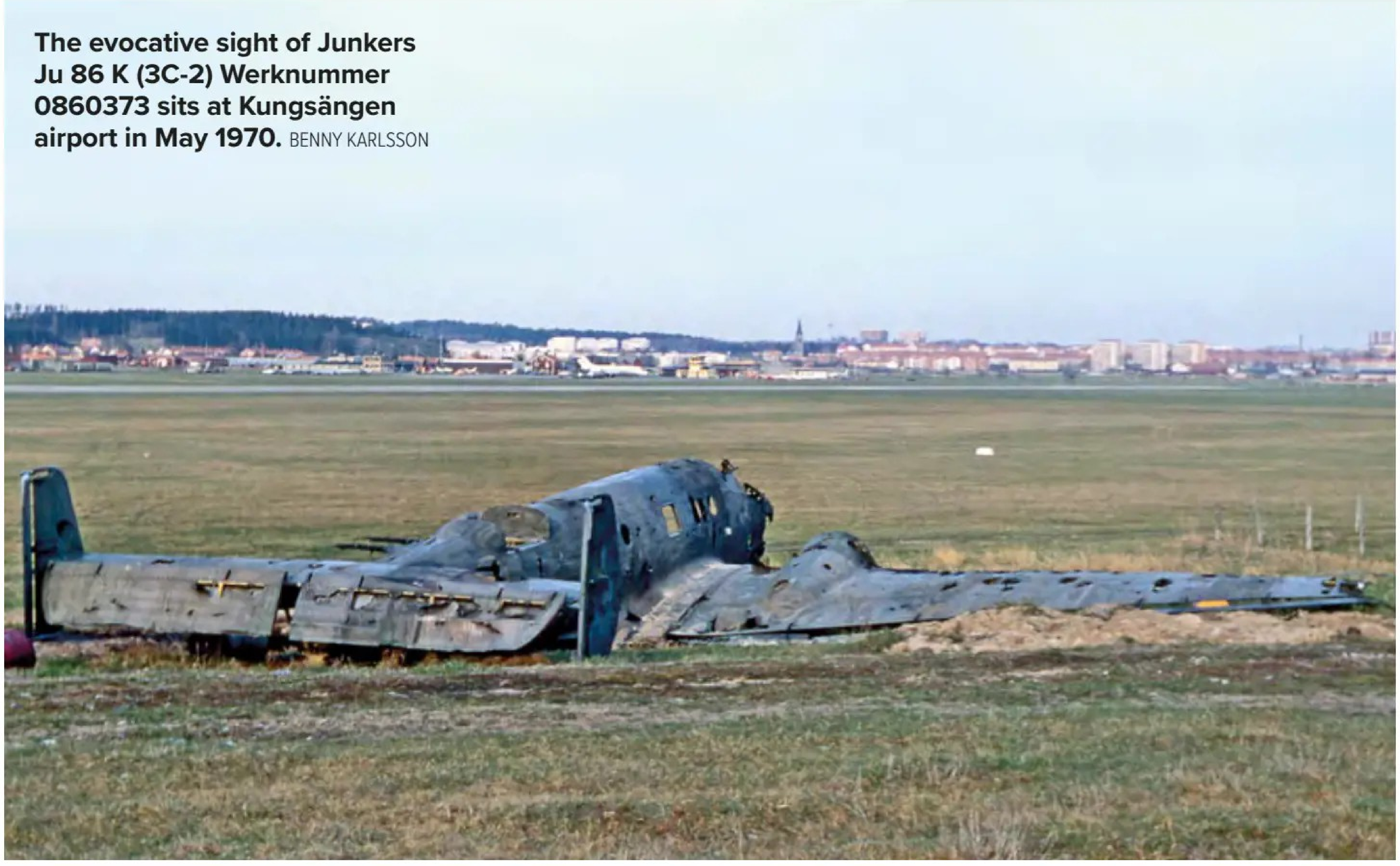
Jan Forsgren

Not the usual attire for one of Dave Barrell's accompanying wingwalkers.

I found the insight into the operational side of the AeroSuperBatics team given by Dave Barrell in the February 2025 issue of *Aeroplane* an interesting read. Over the years I've regularly seen their displays, during which time the wingwalkers have sported many different outfits, but only the one occasion when it was so, well, skimpy; see the accompanying image. This was at a charity fundraising event hosted by Vic Norman at their Rendcomb base in 2008 where five Stearmans put on a spirited co-ordinated performance — or possibly a "bunfight", according to Dave.

In his excellent, lavishly illustrated memoir *Norman Conquest*, the AeroSuperBatics founder included many photos of the team in its various guises but none show the wingwalkers wearing this particular fashion statement. The picture caption on page 86 of the '*Aeroplane* meets...' feature showing Dave in the cockpit — "Wrapped up warm against the British summer elements" — made me smile and muse, "Maybe spare a thought for the scantily clad passenger on the top wing!"

Malcolm Martin


The evocative sight of Junkers Ju 86 K (3C-2) Werknummer 0860373 sits at Kungsängen airport in May 1970. BENNY KARLSSON

I read the letter from Colin West (Skywriters, *Aeroplane* January 2025) with interest. I too served my apprenticeship during the 1964-69 period but with BOAC at the engine overhaul facility in South Wales. The story of the Hyfil blades was quite correct; they were fitted to a Rolls-Royce Conway at our facility using a specially configured stage 1 low-pressure compressor disc in place of the standard item. The first test ended due to severe erosion following flight into rain — it was suggested that the blades looked more like a shaving brush. A redesign of the blades featured a stainless steel insert to the leading edge; unfortunately this also failed.

Clearly Rolls-Royce had the right idea, but unfortunately Hyfil was ahead of its time. I don't know if it's true but I was told the material was trialled as an alternative to cabin floor material.

Les Neville

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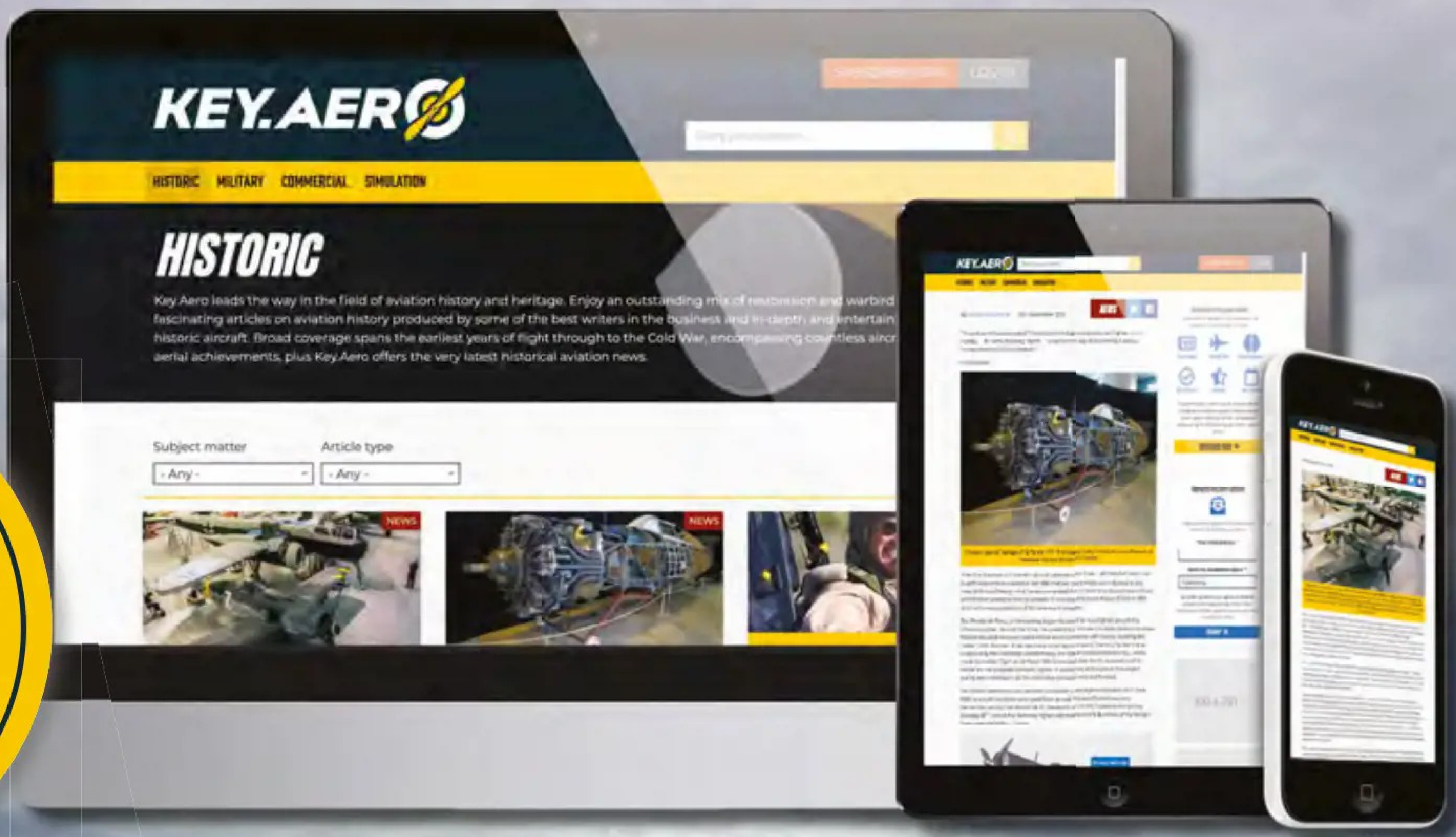

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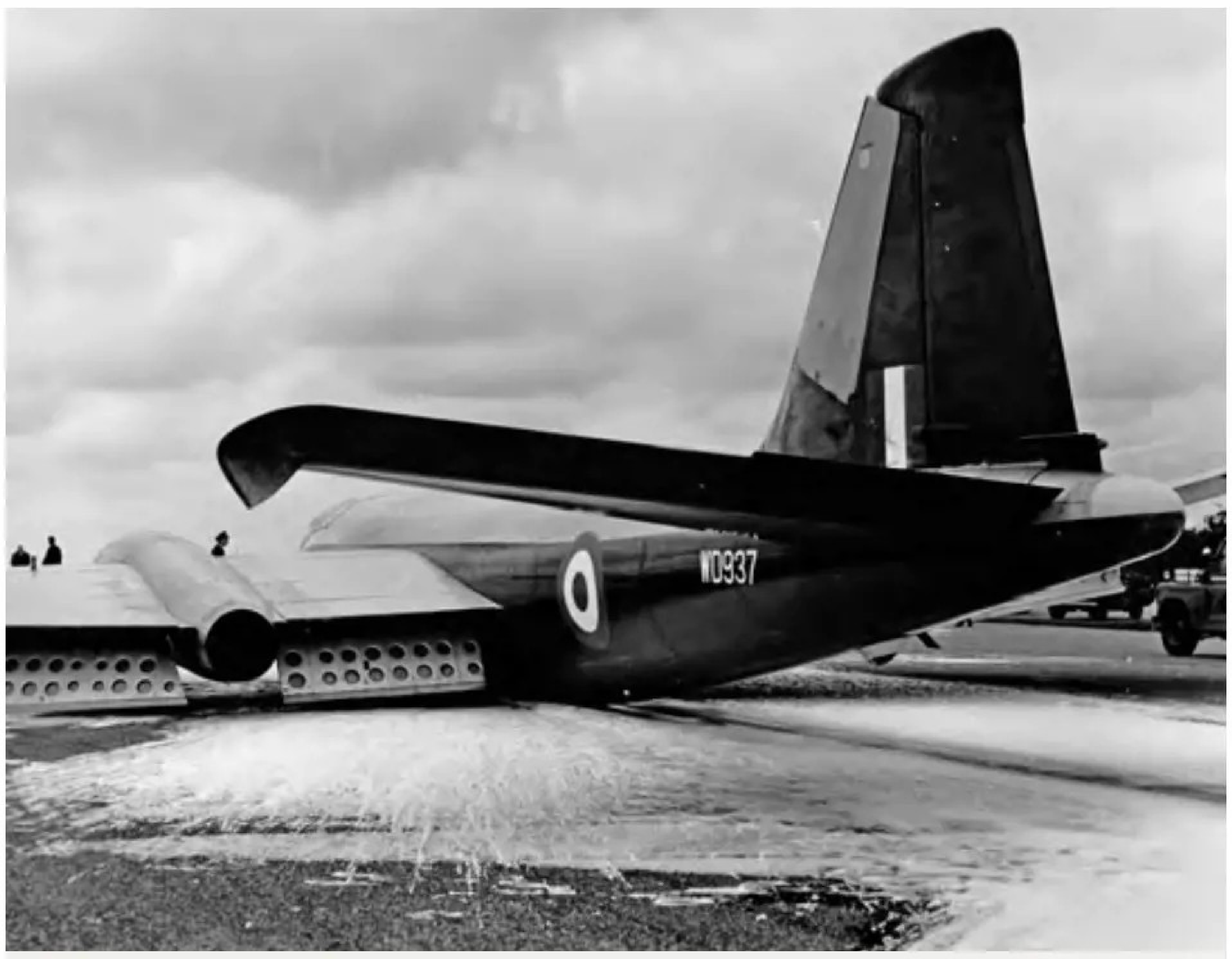
THIS MONTH'S QUESTIONS

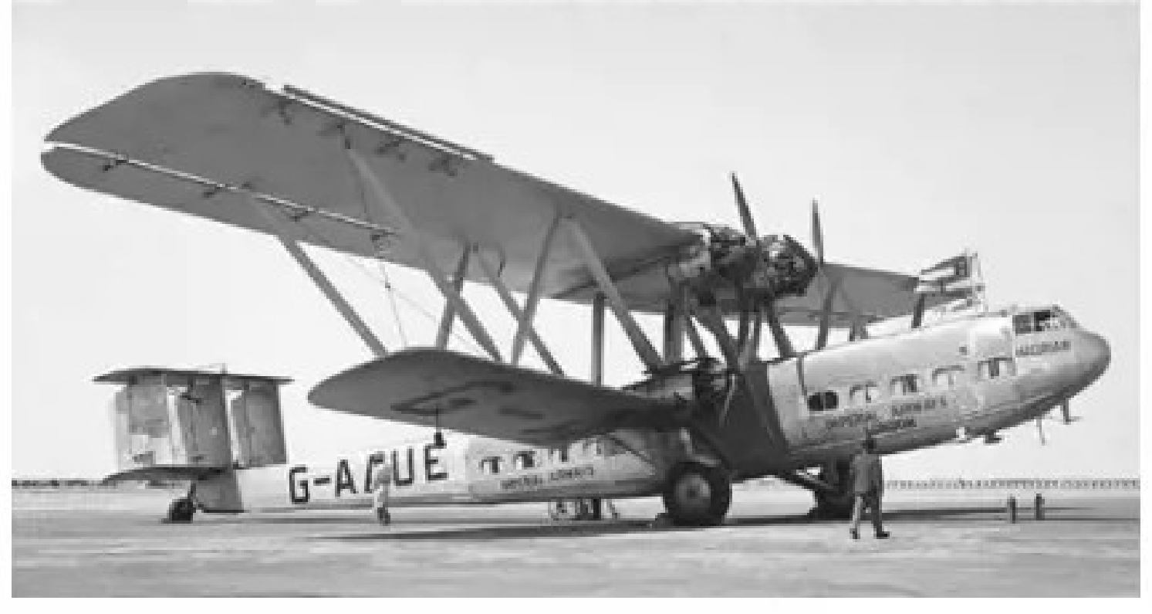


Canberra crash

Q Reading the TSR2 features in the February issue, Jonathan Waite was interested to see a photograph of Canberra WD937 on page 76. It prompted his submission of the above picture of the aircraft following a wheels-up landing, but he would like to know when and where this took place, and what caused it. Most published sources make no mention of the incident, so Jonathan would appreciate any details from readers about the event and whether the aircraft was repaired.

Shaibah details

Q Simon Pearce is compiling a story of the Imperial Airways route to India and much appreciated the feature in the April 2024 *Aeroplane*, 'Imperial Phase' by the late Harald Seabrook-Smith. This covered details of Margil airport on the Shatt al-Arab near Basra, and Simon would like to know when Imperial Airways transferred operations from RAF Shaibah to Margil and when the airline's flying boat services ended and the landplanes began. Simon notes that both the airport and the slipway for the flying boats were quite close with the hotel, opened by the King of Iraq on 25 March 1938, acting as a control tower catering for both seaplanes and landplanes. The Shatt al-Arab Hotel survives today and was used by the British Army as a joint HQ with Iraqi forces during the 2003 Gulf War.



ABOVE: Imperial Airways HP42 G-AAUE *Hadrian* at Margil airfield — also referred to as al-Maqal — in Basra.
UNIVERSITY OF WISCONSIN-MILWAUKEE

Which Concorde?

Q Ray Sellers was on a BA courier flight by British Airways Concorde on 12 September 1988 and would like to know the registration of the aircraft which flew the BA 003 service to New York that day. With the hoped-for information, Ray plans to visit the aeroplane in whichever museum it now resides. Can readers help?

THIS MONTH'S ANSWERS

Slatted Comet

Q Leading-edge slats on the wing of an early de Havilland Comet published in December's Skywriters page caught the attention of Francois Cousineau in the February issue, and he wondered why they appeared short-lived.

A Roger de Mercado says the subject was outlined by chief aerodynamicist David Newman at a lecture given at the Royal Aeronautical Society in 2002. He said, "The Handley Page slats which had been provided on the leading edges of the outer wings were not used initially and only deployed on a few later flights. As the stall behaviour was acceptable with the slats in, they were deleted from the second prototype and production aircraft in the interests of simplicity and weight-saving". Roger adds that stall development on the Comet 1 was relatively easy. The addition of small wing fences prevented the flow breakaway from spreading outboard, thus eliminating any tendency for wing drop at the stall.

Peter Wilkins responded by noting details in Graham Simons' book *Comet — The World's First Jet Airliner*. Leading-edge slats had been fitted to the prototype as an insurance against wing-drop, but they had made little difference to stalling speed, and their mechanical complexity was dispensed with in early trials. Design director R. E. Bishop decided to droop the aerofoil leading-edge to maintain lift, and the prototype was modified and worked well with only a small penalty in cruising speed, so the fitment became standard.

Where is Gargunnock?

Q In the January magazine, Alan Laird asked if anyone could confirm the location of the World War One airfield of Gargunnock in the Glasgow area.

A Brian Stafford responded and, with the help of the book *Forgotten Airfields of WW1*, suggests that while Gargunnock is not listed, there is a Carmunnock airfield, also known as Cathcart/Glasgow. It was sited a quarter of a mile from the village of the same name south of the Carmunnock road and proved to be a very busy base through World War One up to 1918. John Anderson sought the answer from the Airfield Research Group, which responded that Gargunnock was also known as Kincairn or Stirling and in use between August 1916 and July 1917 as a third-class home defence landing ground allocated to No 77 (Home Defence) Squadron operating BE12s and BE2s, but with facilities non-existent its use was minimal. It was located at grid reference NS 708 958.

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AEROPLANE meets JOHN ROMAIN

GETTY

Few figures on the historic aeroplane scene have the flying and engineering expertise of the Aircraft Restoration Company's managing director, dating back some 50 years

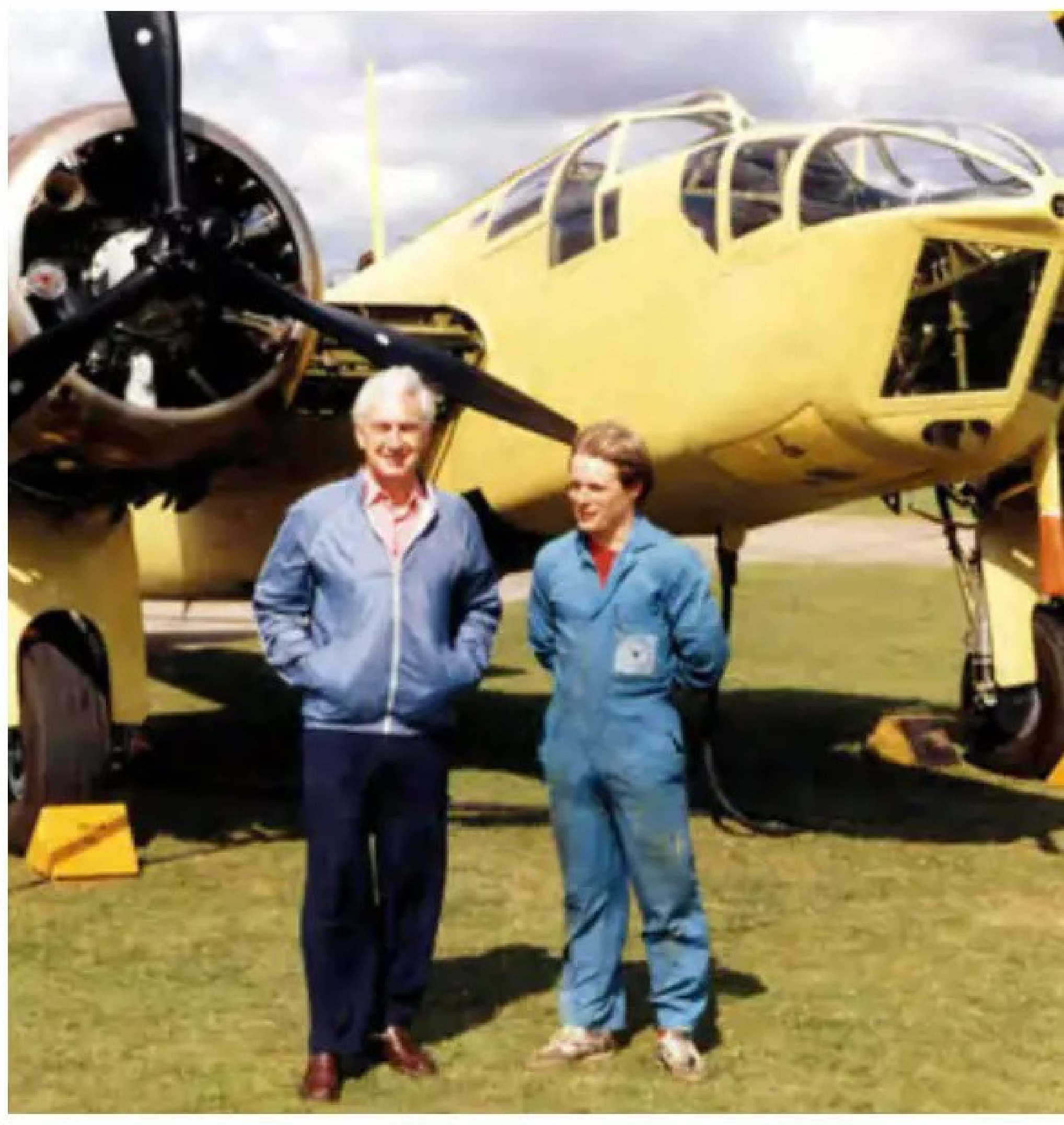
WORDS: BEN DUNNELL

It's one of those events that's impossible to pinpoint. When did the restoration of historic aeroplanes transition from being essentially a private pursuit to a major industry, one encompassing a global network of companies covering every conceivable specialism, all vying for the highly lucrative trade clients put their way? Of course, it was a gradual process rather than a sudden transformation. Yet, make no mistake, it changed the world of aviation heritage forever, introducing a competitive commercial element into what had hitherto been largely the preserve of the enthusiastic, skilled amateur.

Many of the people who today populate the upper echelons of this burgeoning business have grown up in it, for while investment in warbirds can come from many quarters, the specialised knowhow required to put them back into the air — and keep them there — remains a matter not solely of money, but of expertise and passion. As a result, they've witnessed exactly how the scene has evolved. And if one individual could be said to embody this change, it's John Romain. Indeed, the managing director of the Aircraft Restoration Company has been key in bringing it about.

From the spare time he spent in childhood as one of the youngest volunteers at Duxford, before the Cambridgeshire aerodrome opened to the public as a museum, a direct line can be traced through a succession of hugely challenging projects to the present day. We're talking in John's office, on a rare morning off from *Mission: Impossible 8* filming commitments. The only other item in his diary is a practice display in the Blenheim, the aircraft that — from the perspective of both pilot and engineer — has played the most pivotal role in his life. A little while after we finish our interview, John flies the Bristol twin through a routine of the utmost elegance, born of years of familiarity with both mount and venue.

"The aviation link was there", he says of his upbringing.


John Larcombe (left) was a key flying mentor to John. J. M. RAMSDEN

The two Spitfire Ia restorations, originally undertaken for Mark One Partners, are among the crowning glories of John's career. Nearest is N3200, with P9374 off its wing. JOHN DIBBS

The 'Black Knight' T-33 team, its leader and driving force Ormond Haydon-Baillie standing at right, John kneeling at left. VIA ARCo

Back in the hangar come early 1987, Blenheim G-MKIV had its wings fitted and was on the way to completion. KEY COLLECTION

John's father worked in the de Havilland factory at Hatfield, carrying on into the Hawker Siddeley era before retirement. Not too far away, Old Warden became a regular family haunt. "I don't know how old I was when I first ever went there, but I would have been something like five or six, I guess. My father was an avid flying model aircraft-maker, so we used to go over to Wheathampstead — we knew it as 'no-mans' land' on Wheathampstead Common — where there was this flying club of model aeroplanes. Every weekend we were over there. Then, of course, when the Shuttleworth airshows came up, some of those were model flying days. That linked in to going along to the normal flying days, but initially we went because of the model flying days. That's where I first saw the Spitfire XI sitting outside the canteen, the [Sea] Hurricane and a V1."

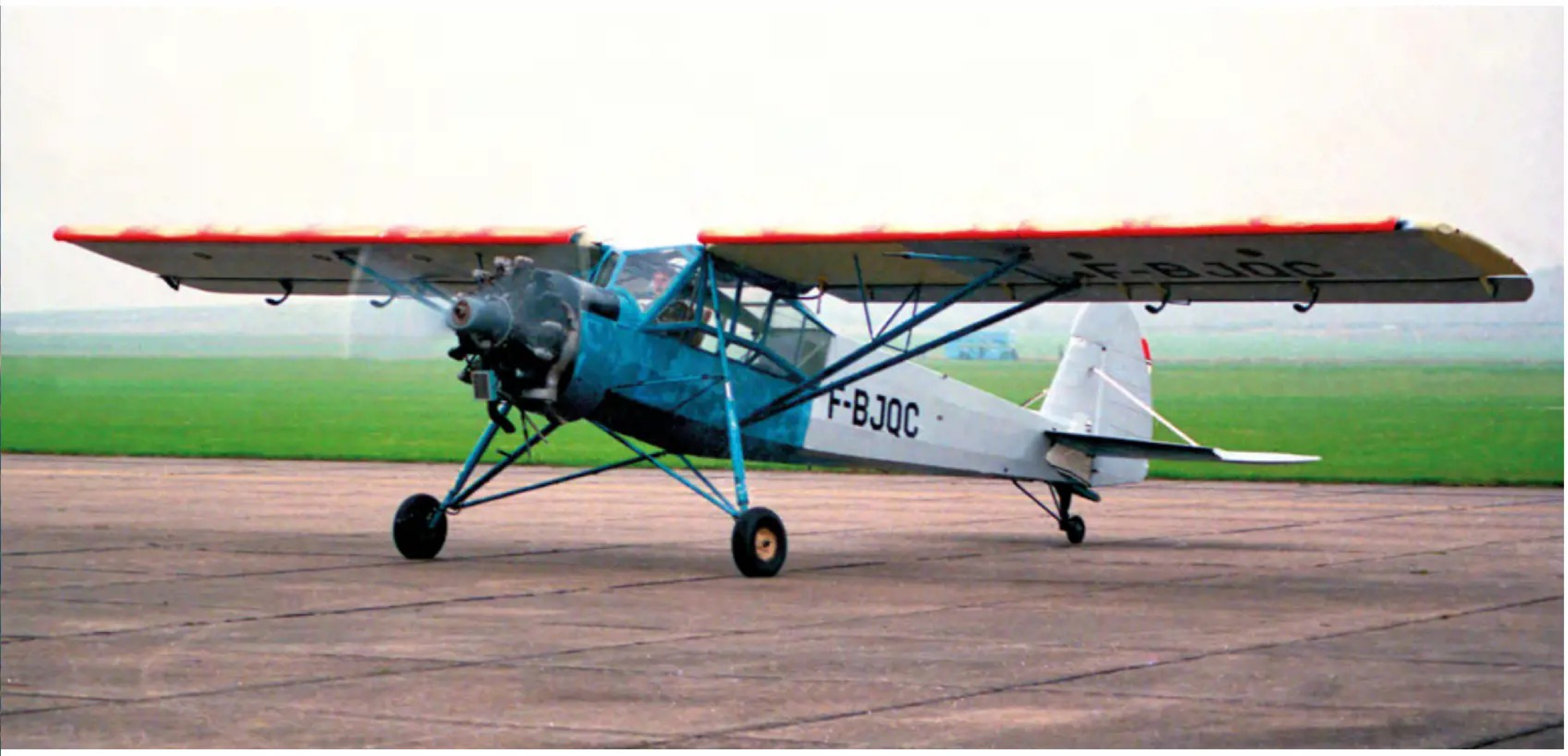
That Spitfire, PL983, comes up again in the story. So do certain aircraft John encountered during his formative years, albeit on the big screen. At 10, he was taken to see the *Battle of Britain* film at the Dominion Theatre on London's Tottenham Court Road. "It was the Buchóns", he says, "more than anything else that grabbed me". When, a couple of years on, he first visited Duxford, relics of the movie-making were all around.

With Chipmunk G-BNZC, which John acquired from Roy Pullan and restored, and Auster AOP9 XR241/G-AXRR, he and Lee Proudfoot formed the Yellow Peril Pair. CHRIS BURKETT

"That was because I had the opportunity to come along with a guy who had begun volunteering for the East Anglian Aviation Society. They were just starting at Duxford in the far hangar, now Hangar 5. All I wanted to do was see the airfield where the film had been made. Of course, walking in it was pretty much as they'd left it. Everything was still in camouflage paint, there was still wreckage of fibreglass Hurricanes and bits of Spitfire everywhere. There was even some of what remained of the chateau over on the far side."

Once the Imperial War Museum began using Duxford as a large object store, preparations were set in train for its inaugural airshow, staged in October 1973. The EAAS volunteers, John among them, played their part. "We were really young people, but there was a group of us getting out there with brooms, sweeping concrete pans, getting the airfield back to being usable

Still a heartbreaking sight, all these years later: the initial Blenheim restoration wrecked on Denham golf course. KEY COLLECTION



LEFT: Morane-Saulnier MS505 F-BJQC as it looked when first bought by BAM from a French owner at Bergerac-Roumanière. John — at the controls here — flew it to the UK in October 1988, reporting how he was overtaken by a hydrofoil mid-Channel. ALAMY

for an airshow. It was epic. We were out on the runway with watering-cans full of tar, filling in all the gaps in the concrete. In those days there were no barrier lines, so we had to build those out of rolled-up wicker fencing. We put the stakes in and put those up. I painted endless 45-gallon drums red, white and red, which were positioned all the way down as rubbish bins."

At that time, the IWM was still to embark on its pioneering arrangements with private owners whereby their airworthy historic aircraft added an active element to Duxford's exhibits. Ormond Haydon-Baillie, English-born but a former Royal Canadian Air Force pilot, would be in the vanguard. Towards the end of 1973 his three flying aeroplanes, Sea Fury FB11 WH589 and a pair of CT-133 Silver Stars — the Canadian-built version of the Lockheed T-33 — crossed the Atlantic, arriving at Southend. One of the T-33s had already been painted in a stunning livery as the 'Black Knight'. A pair of unrestored Bolingbrokes, Canadian-manufactured Blenheims, followed by sea. And a deal was struck with Dr Christopher Roads, the IWM's first director of Duxford.

◆

"We turned up here one weekend", says John, "and there sat the Sea Fury. Wow. Then the T-33 came in, and later on the second T-33. We got to know him, and started cleaning his aeroplanes. He then explained that there were two Bolingbrokes arriving, and all of his kit from Canada and America. He had an agreement with Dr Roads of the IWM that we could have the use of some buildings and a hangar.

"Everything was derelict, so it was a case of choosing which building we wanted as the workshop, the offices and a hangar. The museum said it was down to us to renovate them, because they weren't going to be doing that. We chose Building 66 and went in there. There were odd walls that we didn't need, so they came out, and we completely renovated the building. There was no water to them, no electricity, nothing. All the windows had been smashed [...] so we went around the site finding complete panes of glass to chip out and put into Building 66. We got all the wood for the benches that we built from the old cinema on the north side. We were allowed to forage around to find materials to build what we wanted."

Volunteering for Haydon-Baillie was never dull. "He brought a caravan on site, which we had outside the hangar. He was famous for his breakfasts, and he would drive in from London mid-week [...] and coming out of Royston there was a farm he used to go in to buy duck eggs. He'd turn up here with a tray of them, and that was our staple diet. Every breakfast was duck eggs and bacon, and then we'd be in the hangars or in Building 66 working. We'd work on anything. We had the Meteor F8 that he had acquired, and we spent a number of weeks at Wroughton working on that to get it airworthy, although it never came in to Duxford. We spent weeks at Cranfield getting the CF-100 airworthy, but we did get that flown in. Ormond took his brother and his father for a flight in that. He only had a ferry permit for one flight in...

LEFT: Up front in the second Blenheim. KEY COLLECTION

An early air-to-air sortie for the first Blenheim. KEY COLLECTION

"THE BLENHEIM REALLY WAS FLYING"

The aircraft that changed so much for John, and indeed warbird restoration as a whole, arrived as something of a basket-case. Bolingbroke IVT RCAF 10038 had been recovered from Manitoba by Ormond Haydon-Baillie, along with sister aircraft 9893, no fewer than 19 Mercury engines and large quantities of spares. But anyone who saw all of this after its shipment to Duxford in 1974, laid out in Building 66, would have pondered on how it could possibly ever end up as a flyable Blenheim. Anyone, that is, except the team that started work on it — and which, after Haydon-Baillie's death, was taken on by Graham Warner.

No project quite like this had been seen through to completion before. Apart from the occasion when it was nearly sold out of BAM's hands, there were other dramas along the way. At one stage there were no suitable mainwheel tyres, but suddenly it turned out those used on the Shorts 360 turboprop airliner fitted the bill. Having the propellers overhauled commercially was beyond the budget; BAe's Lostock plant stepped in to rebuild them as a training exercise. Discovery of an original Blenheim battle damage repair manual, and acceptance of its contents by the CAA, negated a far more complex, lengthy and costly main wing spar repair than ended up being done. In all of this and more, Warner wrote in his 1996 book *Spirit of Britain First*, it was primarily John's "dogged determination over the years that enabled us to conquer these decisive difficulties."

Fast-forward to the early evening of Friday 22 May 1987, and the seemingly impossible had been made possible. John Larcombe, chief pilot of Warner's British Aerial Museum, was ready to fly the Blenheim, with John alongside him. G-MKIV — resplendent in the colours of the No 105 Squadron MkIV, V6028, flown by Wg Cdr Hughie Edwards VC — was taxied to runway 06. Power checks and cockpit drills complete, it was lined up and started its take-off roll. But then the Mercuries were throttled back and the attempt aborted. What was the problem? Nothing more, it turned out, than the under-nose escape hatch opening. Romain secured it and they tried again.

Graham Warner recounted the moment: "…this time she lifted off cleanly and was suddenly airborne. We all cheered, slapping each other on the back and shaking hands excitedly. We had done it! The Blenheim really was flying". And it did so very well. John Romain told this magazine at the time, "It flew perfectly, and didn't need any trim adjustments. It's a nice aeroplane — it goes very well and very fast". For 15 minutes they were airborne, ending with some low passes. "We were so exhilarated", wrote Warner, "that we did not notice that it had started to rain again."

On board had been carried a bottle of champagne. After landing it was shared among the team, poured into plastic cups as the rain continued to fall. With the Blenheim put away, they repaired to the John Barleycorn pub in Duxford village. A suitably British way to toast one of the great achievements in aircraft preservation history.

The team celebrates the maiden post-restoration flight. Graham Warner is in the suit. KEY COLLECTION

"Sometimes we'd go away to airshows. In a lot of cases he'd jump in the aeroplane and disappear off himself, but we did get involved with that. And then when he disappeared abroad for a period of time, we were still here working in the workshops. That was when he went off to India, to look at the Spitfires. He was spending quite a lot of time out in Germany buying Sabres, and then in Italy buying I-BILL" — a Cavalier Mustang acquired in 1977 from Italian industrialist Giorgio Billi.

"The first time we ever saw I-BILL was when he'd finally managed to purchase the aeroplane and it was due to go into Greenham Common for the Tiger Meet [at the International Air Tattoo]. He'd flown in to the country and landed at Gatwick. We were already at Greenham Common waiting for it to come in.

When Blenheim number two, G-BPIV, flew in 1993 it was marked as No 68 Squadron night fighter Z5722. KEY COLLECTION

He called us and said, 'I've got to leave it here for the night.' We drove over to Gatwick and picked him up. He was meant to be going to some big dinner with his brother at a manor somewhere, so we dropped him there. The following day the Mustang flew in to Greenham Common, and I was lucky enough to be in the back seat."

It was in I-BILL that, just a few days later, Ormond lost his life. He and a young German passenger were killed on 3 July 1977 when the Mustang crashed during a US Army event at Mainz-Finthen. Back in Britain, his team was understandably shattered. "We imagined everything would stop and that would be the end of it", says John. "Wensley, his brother, called a meeting here at Duxford and said what we were going to have to do was collect all these aeroplanes". An expedition headed by Wensley recovered the Spitfires from India, after which John and others brought the Sabres out of West Germany and repaired the Sea Fury, which had also been there. Gradually the collection was sold off, but a saviour would emerge.

In the meantime, John had left school and secured an apprenticeship at Hatfield with Hawker Siddeley — later British Aerospace — Dynamics on the missile side. While those five years involved their share of frustrations, Hatfield was a great training ground, and it gave John options for the future. But there was fresh hope at Duxford, too. Graham Warner was a former RAF pilot, racing driver, team manager and owner of a specialist sports car garage based in Chiswick called The Chequered Flag. By the late 1970s he was involved in rallying with a Lancia Stratos, as well as sponsoring Robs Lamplough in historic racing. That was the crucial connection.

Already a Harvard owner, in 1976-77 Lamplough's Spitfire and P-51D Mustang recoveries from Israel had arrived at Duxford. One of the Mustangs, serial 44-72216, was chosen for restoration. "That aircraft", says John, "went into the workshop next to us and they started working on it. Meanwhile in 66, the Blenheims were sitting there, the engines were sitting there, and nothing was happening because we were busy off doing other things. Then Robs learned that Wensley wanted to sell them, and so it was Robs who called Graham…

"Graham came up to see them in 1978. His interest initially was to do it as a memorial to his brother, who had been lost in a Halifax during the war. He liaised with Wensley to purchase all the Blenheim spares, the two Blenheims and also a Chipmunk. Graham then got an agreement with Ted Inman at the IWM to keep the workshops and build the aircraft at Duxford. At the end of all that, once the first aircraft was flying and we were happy, the second one would be gifted to the museum."

This was the start of the British Aerial Museum. "Graham got the Chipmunk finished, and he renewed his pilot's licence on it and flew that aeroplane around with us. He then wanted more machines, and I think the

ABOVE: **Approaching to land at Duxford during June 1995 in Brian Woodford's Lysander, at the conclusion of its ferry flight. ARCo went on to refurbish and operate the aeroplane until Woodford sold it.** BEN DUNNELL

first one he added was the Storch, the MS505. That became the next flyer that started to go around doing airshows, with John Larcombe and other BAM pilots. We got the Broussard out of France, and the Beech 18s came up: three of those sitting at Prestwick. We purchased two of them — the other one went to a Scottish museum — so both of those came here. We built one for us to fly, and the other one was sold to Tony Hutton, which formed the start of his Harvard Formation Team with the Beech. Graham sold the Storch to the East Fortune museum, which is where, ironically, it's come back from. He missed it so much we went and got another one, which we found in France."

For John, with his apprenticeship ending in 1980, it was a very easy decision to go into historic aviation as a profession, even if many of his BAe colleagues thought it misguided. "To get the Blenheim going, Graham had employed an engineer who was here full-time … It wasn't long before everyone realised this guy simply wasn't the right person. I'd told Graham that BAe had put me onto another missile contract, and it didn't appeal… He said, 'Would you consider coming and working at Duxford full-time?' From the point of view of wanting to do it, yes, of course I did, but it was a big pull for me. I had to leave home and find somewhere to live, and the wage Graham was going to pay me was less than British Aerospace was paying me, so there was a financial hit as well. But I wanted to do it, so that's what I did."

Alongside him was a volunteer group including some tremendously experienced hands. Through Robs Lamplough's engineer Norman Chapman — "a great tutor in airframes and engines", says John — Warner retained the services of Fred Hanson, who had been the supervising licensed engineer while the Blenheims were still in Haydon-Baillie's ownership. Joining them was Edgar 'Chalky' White, a significant addition when it came to restoring the Bristol Mercury powerplants, especially since successor manufacturer Rolls-Royce offered no help.

"Amazing people", John reflects. "Both 'Chalky' and Fred had worked for Freddie Laker, so they knew each other very well. 'Chalky' was pretty much retired, so Fred said to him, 'If you want to stop sitting and watching the telly all day and go out and do something with your hands again, go to Duxford and start working on these engines.' It was 'Chalky' who taught me all about engines — how to build them from nothing, which was what we were really doing, how to look after them. I learned a considerable amount from him. Bless him, he never actually saw the first aeroplane fly."

The whole project was plunged into crisis at the end of 1984 when The Chequered Flag, via a complex set of circumstances, was put into receivership and subsequently sold. While the other BAM aircraft were unaffected, the Blenheim was on the company's books, and the new owners sought to dispose of it. "Eventually", recalls John, "the Blenheim was bought back by Graham from the receivers, but there was no money. We had to create the funds to restore the aeroplane, as well as doing the work."

For John himself, 1981 was the year he learned to fly. "Some of the other collectors like Robs and people were saying they knew I was working on Graham's aeroplanes full-time, but if I got some spare hours at weekends, could I work on theirs? I agreed to do that, and the payment for it was learning to fly. Robs spoke to Graham and said, if they sent me off to get my PPL sorted out — because none of them were licensed, and the airfield wasn't licensed to do that — and got me checked out on the Chipmunk, I could start flying. I went to Bourn with the money I was earning from doing outside engineering, and eventually got my PPL.

"I remember coming in with it and saying, 'I've got a PPL!' I think it was Larcombe who said, 'That's very nice', threw it on the desk and told me, '*Now* we'll teach you how to fly properly'. It was straight into a Chipmunk from base level. They could do that then because I had the PPL, so I could go solo when they let me". Rapidly he progressed to the MS505, an Auster AOP9 bought by Warner at a Duxford auction, the Broussard, and the Beech 18 as his first twin. "Robs allowed me to fly his Harvard, and I did most of that with 'Hoof' Proudfoot, who'd started flying for The Fighter Collection. Lee Proudfoot and I were gradually climbing up into flying all sorts of different aeroplanes, so I'd got to know 'Hoof' pretty well. I then sat within that group for flying."

When the Blenheim triumphantly took to the air on 22 May 1987, John was co-pilot to John Larcombe. The pair saw the aircraft through an almost trouble-free flight test programme, completed in a few days, and its debut displays at Biggin Hill a couple of weekends afterwards. For a Guild of Air Pilots and Air Navigators event at Denham on 21 June, however,

LEFT:
About to take Alex Henshaw flying in Spitfire IXT PV202, freshly restored in March 2005 to sport its old Irish Air Corps colours.
KEY/DUNCAN CUBITT

Roy Pullan was to assume the seat hitherto occupied by Larcombe. Pullan was at this stage the only other BAM pilot accepted by the insurers as suitable to fly the Blenheim, even though — as Warner wrote — the younger of the two Johns was himself eminently qualified. It proved a fateful choice.

The events of that day are all too well-known. Having previously opted not to land at Denham as the runway was too short, Pullan decided to perform an unplanned, unbriefed touch-and-go. John was again in the cockpit as co-pilot; he later told the accident investigators that Pullan "rapidly opened the throttles and both engines suffered rich mixture cuts". His advice "to close the throttles and open them up again more slowly" went ignored, and when the starboard Mercury opened up to full power the Blenheim left the runway. It crashed on an adjacent golf course, hitting trees and cartwheeling. John and engineer John 'Smudge' Smith escaped unaided with minor injuries; Pullan was helped from the wreckage by the rescue services. The fact that there was no loss of life came as a relief, but for Warner and the BAM team the Blenheim's destruction was a terrible blow.

"By the time it did fly", says John, "there was very little money left in the pot. When it crashed, there I was sitting in a hospital bed thinking, 'That's it now. It's really finished'. Without that aeroplane I'd fundamentally lost my job, and for the only time in my whole life I was standing in the dole queue in Cambridge, drawing money and wondering, 'What on earth has this all come to?' I really thought I wanted to get out of vintage aviation — to get a commercial licence and go and fly with the airlines. I went to White Waltham to do my commercial!"

> ***"I was sitting in hospital thinking, 'That's it now'"***

Again, though, fate took a twist. Not least due to an overwhelming public response, within days Graham Warner committed to a second Blenheim restoration. As John recounts, "There was quite a nasty court case where Roy Pullan's people were trying to convince the magistrates there was something wrong with the aeroplane and it wasn't his fault. We all ended up having to stand up in court, me especially because I'd been sitting next to him, explaining what had happened — bearing in mind there was a lawyer really trying to rip me to shreds by saying, 'No, you built the aeroplane wrongly and that's why the engine failed. It had got nothing to do with my client'.

"Eventually they found against Roy and said that, actually, it was his fault. Graham then had got the insurance for the aeroplane. Roy owned two aircraft, a project Chipmunk and a project Tiger Moth. He sold those to me. I put the Chipmunk into Building 66 and restored it fairly quickly, with the idea of that being my first ever aeroplane. I flew it for a number of years before it eventually was sold, and it's now with the Shuttleworth Collection."

It helped fill the time until the 'new' Blenheim, again an ex-Canadian Bolingbroke, arrived. Acquired from Sir William Roberts, the airframe was transported down from Strathallan in February 1988. "There was a little bit of money to get on with it", says John, "but not much. Because I'd been working on so many other people's aeroplanes and doing my own thing so much, I said to Graham I wasn't going to go back to just working for him. He suggested we form a joint company, that we both be directors of it, and that one of the projects be to get the second Blenheim flying". This, during 1989, was the start of the Aircraft Restoration Company.

The engineering aspect aside, John now played a full part in display flying. He'd started out on the circuit in 1984, his debut

BELOW:
TFC's B-25D Mitchell *Grumpy* was a familiar steed. At Flying Legends 1997, John flew it in the 'Balbo' alongside the Duke of Brabant Air Force's B-25J and the Blenheim.
BEN DUNNELL

RIGHT: Accompanied by the aircraft's former co-owner Thomas Kaplan, Prince William shakes hands with John at the July 2015 hand-over of Spitfire Ia N3200 to the IWM. ALAMY

performance being at Duxford in Auster AOP9 XR241 on 6 May. "Of course it was something I'd always wanted to do, but I couldn't actually believe, to begin with, that I was doing it. It was good fun. Some of the other, bigger boys were watching, and in particular Lindsey Walton. Lindsey asked us to look after his 'Bf 108', Stearman and Corsair from a maintenance point of view. 'Hoof' was gradually trying to suck us more and more into the world of The Fighter Collection, so there were opportunities there. I started flying the Beech Baron for them, mostly transiting people around, but it was brilliant experience learning things from not only 'Hoof' but also Jack Brown and all the other pilots they were using.

"And then the Hannas as well — Ray and Mark started to pick me up. The first serious Harvard job I ever had was flying the camera-ship for *Piece of Cake*, where again I was linked into being with some very talented people and learning so much very, very quickly. One day we were flying into Friston, a little coastal strip they regenerated for the filming. There I was flying in with the Harvard, and I had Ray Hanna sitting in the back seat. OK! Lots of opportunities were coming in for flying."

A hoped-for berth in TFC's fighters having not materialised, the ever-supportive Lindsey Walton stepped in. "Lindsey walked into our offices, which were still in Building 66 in those days, and put a book down on my desk. I said, 'What's that?' 'It's the pilot's notes for the Corsair'. 'Oh, do you want me to put them in the file?' 'No, I want you to read them, because next Wednesday afternoon you're going to fly it, so read 'em well'. I looked at him and went, 'You're kidding, aren't you?' 'No, I'm serious. Next Wednesday afternoon, you're going to fly it'. That was the first fighter warbird I ever flew."

> ***"I couldn't believe I was doing display flying"***

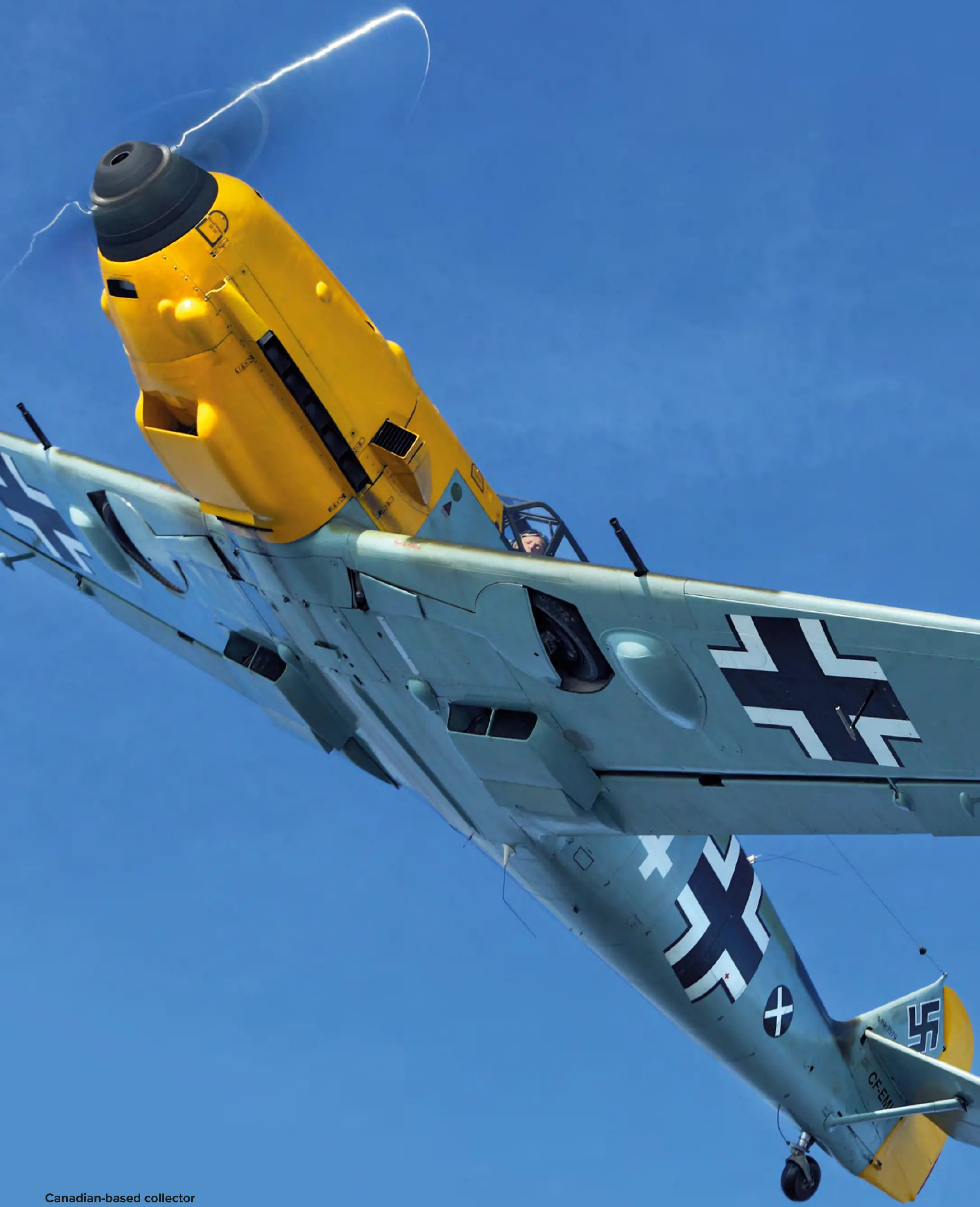
Many more have followed. Thanks to the Hannas and the Old Flying Machine Company's legendary Spitfire IX MH434, 1991 brought another 'red letter' day. "I'd flown the Corsair, and Mark and Ray were here one day and said, 'If you've flown that, do you want to have a go in MH434?' We'd started to do some maintenance on it by then. The pair of them briefed me, and off I went… The following day was my birthday, and they said it needed to go up to Alconbury — 'take it'. I flew it in to Alconbury, and my parents came along to see my first 'away' trip in a Spitfire. My next transition to a big fighter was with Anders Sæther and his Mustang. *Old Crow* was the first P-51 I flew."

Great enjoyment came as a regular pilot of TFC's B-25D Mitchell, most often sharing captaincy duties with Ken Fitzroy. "It would be the lead aeroplane going into the Continent, so we'd go over to La Ferté-Alais with the B-25 and four or five fighters, at least, or into Norway, Sweden and all sorts of places… I loved it". Plane Sailing, too, entered the picture. "During the same period, Paul Warren Wilson came to me and said, 'John, we could really do with another pilot on the Catalina now and again. Would you be interested?' I said I'd have a go!"

All the while, the Blenheim was getting closer. "We'd already learned a lot, and we thumped into it pretty hard. To do that within five years was incredible". Of course there were difficulties to overcome, such as when the wing spar material — no longer available in the specific type of steel required — had to be rehardened, a process hitherto felt impossible. So tight were funds that Warner had to take out a £100,000 bank loan. But it all came good, and on 18 May 1993, in the hands of 'Hoof' Proudfoot with John as co-pilot, the maiden post-restoration flight took place. So quickly was the test schedule completed that just three days on, having never been able to fly the first Blenheim himself, John achieved a long-held ambition by taking command of this one. Starting at Mildenhall, he launched the aircraft onto the display circuit.

Some seasons were busier than others, but the Blenheim became a fixture at major commemorative occasions in John's hands. There was 1994's D-Day 50th anniversary flypast over the Royal Yacht *Britannia*, the VE-Day 50th above Buckingham Palace in 1995, and during 2000 the honour of leading the Queen Mother's 100th birthday flypast, among many more. "Flying that particular aeroplane", he says, "opened up a lot of very memorable things."

And John feels the significance of both Blenheims is hard to underestimate. "The first Blenheim in Building 66 really kicked off the restoration industry, which it is now. Some people don't like the word, but it is an industry, and it employs a lot of people — not necessarily in the core companies, but if you look at the amount of outside contractors and companies that are involved in producing, now, a restored aeroplane, the number of people involved is huge. That really all started from the Blenheim…



Canadian-based collector Ed Russell's Messerschmitt Bf 109 E-4 was the first of the type John piloted. JOHN DIBBS

"Nobody had done a restoration anything like the Blenheim. All the big people were saying, 'You'll never do that. It's impossible'. But we did. That led other people to have the confidence that they could do similar things. The various companies we had found to help us then helped them, and it worked. By 1993 and beyond that, more and more of this work was starting to happen, and more and more investment was starting to happen in enabling serious restorations. And one of the people who really did put his money where his mouth is was Karel Bos."

The owner of Bosal, an immensely successful automotive components firm specialising in exhaust systems with manufacturing facilities worldwide, had started a collection of historic aeroplanes in Antwerp. "In his heart", John says, "he wanted a Spitfire. He made that known to Historic Flying, and they sold him Eddie Coventry's MkXVI, TD248". As a result, Bos received word that Historic Flying was in trouble, and — cutting a long story short — he bought the Audley End-based firm. He ended up acquiring several Spitfire projects in the process, like MkV JG891, MkIX MK912 and MkXVIII SM845.

One day Bos turned up at Duxford in TD248 with a snag. He went to ARCo and asked for it to be looked at. John agreed to do so, whereupon Bos went home and left the aircraft with him. "We put it in the hangar, had a look round, fixed it, cleaned it". Returning about a week later, Bos was delighted — so much so, he asked John whether he could buy ARCo as well. The rationale was that he wanted a maintenance centre to complement the restoration facility at Audley End. Says John, "I explained it didn't matter what the price was: it wasn't for sale… I was of the mind, 'Cheeky bugger'. He was of the mind, 'Stubborn bugger'. We parted for about a year-and-a-half."

When they met again, it was in the office of Duxford's director Ted Inman. Bos explained how he understood ARCo was not for sale. What he now wanted to do, with Inman's blessing, was to move Historic Flying to Duxford, build a new hangar at the eastern end of the airfield at his own expense, and have the two companies share it. This John agreed enthusiastically to. "We became very, very good, close friends. We developed Historic

Enjoying the handling of Buchón 'Yellow 10'. JOHN DIBBS

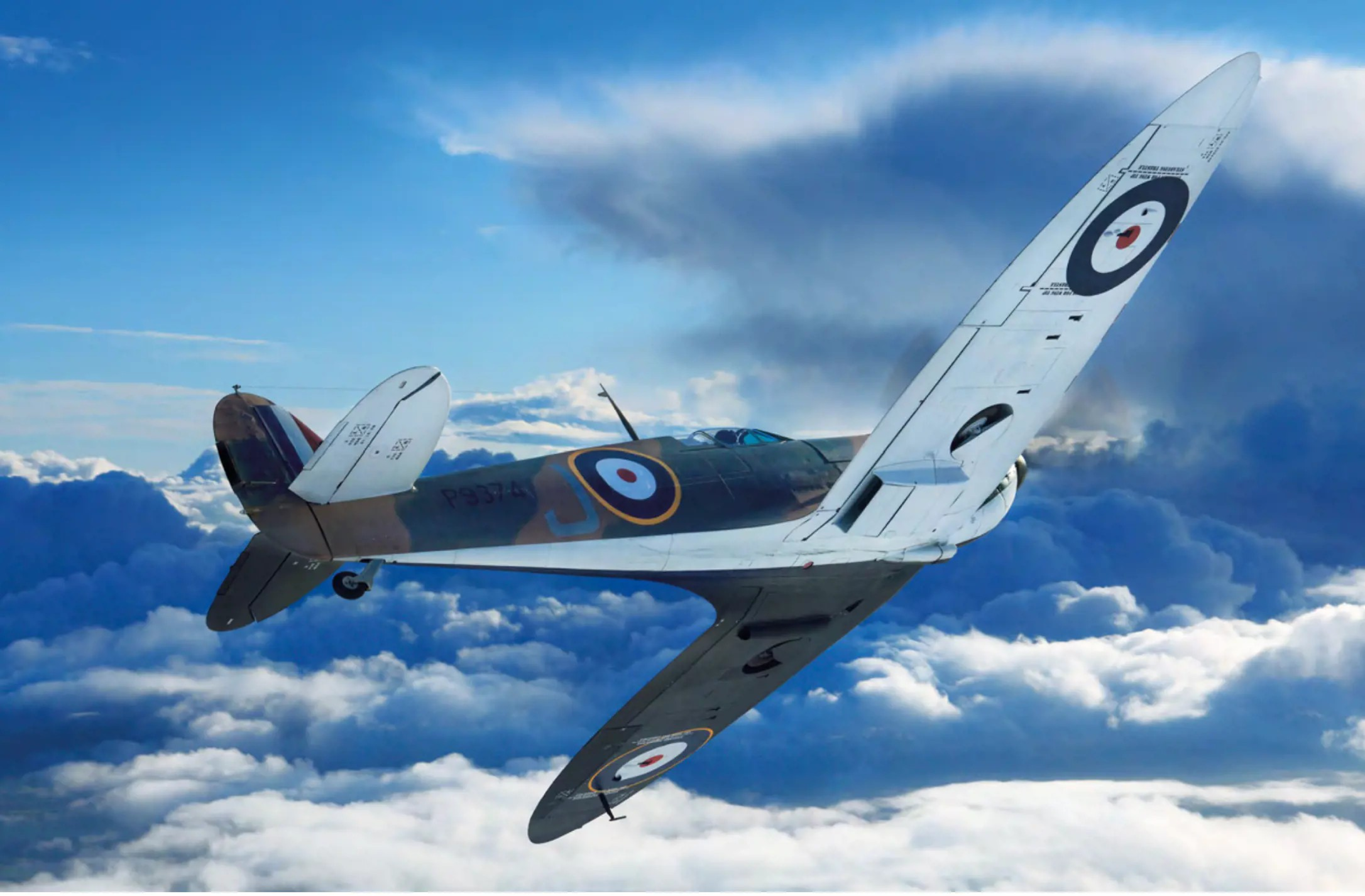
TAMING THE BUCHÓN

Before he flew Ed Russell's Bf 109 E, on visits to 'Connie' Edwards' collection John had already tapped into the great Texan aviator's knowledge of the type, as honed on the Spanish-built Hispano HA-1112 Buchón while filming *Battle of Britain*.

"'Connie' was brilliant", says John. "He said I'd have no trouble as long as I stuck to the rules, and he taught me all about the problem with the undercarriage geometry, too much torque, where you should put the stick on take-off and all that sort of stuff. 'Connie' always mentioned that when they were on the *Battle of Britain* film, he was talking to Adolf Galland about flying Buchóns, 109s and the like and Galland said to him, 'When you walk out onto a line of aeroplanes, you look at them and hope the aeroplane's going to fly well for you that day. With these things, you walk out to the line and the aeroplane looks at you and hopes you fly well that day'. It's in control — you have to tame it.

"Coming back here, now I'd got 109 E experience, and Tom Blair had arrived. He'd come through [ARCo pilot] Cliff Spink, fundamentally. He had aeroplanes in Florida, and he wanted to get into Spitfires. We — Historic Flying at that time — had some that were for sale, and so he bought TD248, the XIV [RN201] and the V [JG891]". Adding to them in late 2006 were the Buchón and Hurricane XII which had been operated by the Real Aeroplane Company at Breighton for owner Robert Fleming. Once Brian Brown and 'Taff' Smith had delivered them to Duxford, "Tom said to me, 'Right, off you go then'. 'What do you mean, 'Off you go then'?' 'Well, it's a 109. Apparently you can fly those, so go and fly it!' That was my first Buchón trip.

"We started to operate that Buchón very well, and everyone around us was wondering how we were doing it… We always said, touch wood, we were sticking to a rule-book and it seemed to be working. Touch wood, it still works. It certainly is an aircraft that will surprise you. It's like it's got its own mindset". ARCo still has the Buchón on strength, since 2009 as part of its own fleet.



ABOVE: **A stunning view of Spitfire Ia P9374, soon after its maiden flight in the late summer of 2011.** JOHN DIBBS

Flying, we finished the Spitfires. Eventually he said he was of an age where he didn't need to keep running this. He fundamentally passed Historic Flying to me, and it went on from there.

"Karel was the one who really put a big marker in the sand on how to restore an aeroplane, in particular a Spitfire, and put the finances there to make it happen. Many people said he was wrong — I mean, you don't have to go that far back to when he said we would produce a Spitfire that one day would be worth a million pounds. Everyone said he must be having a laugh, that he knew nothing about the market. Funny old thing: who was the first to sell one for a million pounds? Karel Bos."

That was MK912, bought by Ed Russell for £1.3 million. Following a huge legal settlement with Disney, Canadian architect Russell had, in John's words, "a passion to buy a Spitfire". With it delivered to his base at Niagara South, he purchased Hurricane XII RCAF 5481 and Messerschmitt Bf 109 E-4 Werknummer 3579 from David Price in California. ARCo put in place Russell's engineering and flight operations set-up, and John thus spent a lot of time in Ontario. As a result, he finally got to fly a Bf 109.

Despite the company's intimate familiarity with Spitfires, when Thomas Kaplan and Simon Marsh came along with their MkIa projects, they presented a challenge all of their own. "A number of years before that, we had done an article for the *Financial Times* [...] about owning a warbird. Kaplan had seen that in New York and called Simon, who was a schoolfriend of his — and future family friend — and asked if he'd seen it. Wouldn't it be lovely, he asked, to own one? Kaplan being a big art collector, with an eye to art, decided that if they were going to own one it had to be a pure one. It had to be a MkI."

> "The Spitfire Is were going to be just as they were"

As Mark One Partners they purchased two, both examples that had force-landed on the beaches of northern France during the Dunkirk evacuation and been recovered from the sands years later. P9374 had been in the collection of Jean Frelaut in Vannes, while the remains of N3200 were exhibited in the Mimoyecques fortress museum. From Malta came Seafire II MB293. "But", John remembers, "they were all sitting in storage with nothing happening. They were doing the rounds of asking who would restore them and who should restore them."

Kaplan and Marsh had been put off approaching Historic Flying, thinking it only restored aircraft for itself to sell on. Then, London fine art dealer Johnny van Haeften, who sold to Karel Bos and Kaplan — the latter possessing the world's largest private collection of Rembrandts — sat them together at a dinner, saying they had something in common he wanted them to talk about. They thought it must be art-related, but no. As van Haeften pointed out, Kaplan and Bos both owned Spitfires. A mutually beneficial restoration agreement emerged from this less-than-chance meeting.

In 2007, John continues, "The projects arrived, and also the description of how they wanted them built. They said they knew we restored aeroplanes very well and integrated certain modifications that were deemed necessary, but they didn't want any of that. They were going to be exactly as they were

ABOVE: Originally restored with a Vokes tropical air filter, Spitfire Vc JG891 was among the examples purchased by Karel Bos before being sold on to Tom Blair. Now the aircraft is part of the Comanche Fighters stable. JOHN DIBBS

just before they arrived on the beach. Costs would be discussed, but that was what they wanted. We had to de-mod all of our drawing sets. We sent the fuselages to Airframe Assemblies and said they had to be real MkI fuselages — not like a MkV with the odd bracket and the rivet lines changed, they had to be MkI. The propeller was to be a two-pitch de Havilland propeller, and they didn't exist. We started from scratch and had them manufactured. The engines: Merlin IIIs with the old magnetos, with the old carburettors. Many people questioned this, but that is what we did.

"A lot of the research I did through Alex Henshaw, who was just down the road in Newmarket. I called Alex and said I needed to talk about Spitfire MkIs. 'OK,' he said. 'I'll come and see you.' In he came, and we were walking around the projects. I wanted him to tell me, if we produced a real MkI, what the pitfalls were. 'No negative g,' he said, 'but other than that… Are you putting the hand-pumping undercarriage in?' I told him yes, we were. 'I loved that.' So it wasn't a problem? 'No, and in a lot of ways it's better because at least you know where the undercarriage is.' Fair enough.

"We got on to the fabric ailerons, and I explained how everyone was telling us they'd got to be metal. 'Why?' Apparently, I said, they just don't fly well, they're too stiff. 'How fast do you want to go?' I didn't know — maximum 300mph? 'You'll be fine, then.' Above that, he told me they got a bit horrible, but below that they were lovely. 'If you leave them, John, and you do your normal aerobatic display — what are you doing, maximum 240mph? — you'll love it.' And he was absolutely right."

Both aircraft were finished just as intended, John completing P9374's first flight on 30 August 2011, and N3200's on 26 March 2014. Tragically, Simon Marsh never saw the second Spitfire in the air, having been killed in 2013 when his Pipistrel ultralight crashed in Italy. "Tom lost the interest, because he wasn't sharing it with anybody any more, and it was a big loss to him. That was when he asked me what we should do with the two aeroplanes. 'Whatever happens to them,' he said, 'it should be charitable.'… He was thinking of gifting N3200 to the RAF and that P9374 could be auctioned with the money going to the RAF Benevolent Fund, with a bit for his big cat charity which looks after panthers, lions, tigers and so on all over the world. He's probably the biggest conserver of those species there is.

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"We spoke with Christie's, and P9374 went to auction. It was eventually bought by the Lauder family. Then there was a discussion on N3200. I said it was a Duxford aeroplane; it flew from here, it was flown by the then officer commanding No 19 Squadron, it's got big Duxford links. Tom asked what we should do. I suggested we leave it at Duxford. He didn't just want to leave it: 'Should we gift it?' That would be nice, if the museum would take it on, because normally it doesn't fly its aeroplanes. He said if he gifted it and put in the condition that it stayed flying, with us looking after it, wouldn't that be OK? They were asked, they said yes, and it was gifted with Prince William here in 2015."

That May, both MkIas took part in a quite superb formation at Duxford's VE-Day 70th anniversary show — John led them in the Blenheim, first-footing in short-nosed MkIF form. A third Blenheim restoration had not been in the plan, but a further needless incident back in August 2003 had rendered it necessary. With another pilot at the helm, fuel starvation due to an incorrect mixture setting caused the failure of the starboard engine while returning to Duxford from a display near Ringwood. The aircraft didn't make the runway, impacting the M11 motorway embankment and sliding onto the airfield.

LEFT:
Since it took to the air again in late 2014, the Blenheim has made for a very different sight in short-nosed MkIF guise. JOHN DIBBS

Graham Warner had long since retired from ARCo, but he retained an interest in the Blenheim. "Once the second one hit the ground", says John, "that was it for Graham. We agreed that because I was a part-owner of it by then anyway, he would walk with the insurance money and I'd keep the aeroplane, and somehow I would finance getting it repaired and flying again… For me, it had to be different. I couldn't do another long-nose Blenheim. We had the MkI nose that was gifted to us. Let's make it a MkI. Then it's different, and unique."

The Blenheim had taken 11 years to put back into the air. In parallel, another story was coming full-circle. Warner's acquisition of Lysander IIIa V9300 in 1982 should have resulted in an airworthy specimen, but the need to rationalise when the first Blenheim was lost prompted its sale to the IWM. The expertise John and his colleagues had built up regarding Mercury engines led Brian Woodford to place his Lysander with ARCo, which rebuilt its powerplant and operated the machine for three seasons until Kermit Weeks bought it in 1998. It was from Weeks that V9312 was obtained, 15 years of restoration coming to an end in August 2018, when it became the sole British-built flying 'Lizzie'.

Some of the long-running threads in John's story are remarkable. The 'Black Knight' CT-133, one of the first aeroplanes he worked on, ended up with the Golden Apple Trust, and in the early 2000s became the only jet John displayed. The P-51 which Robs Lamplough started restoring next door to Building 66 was operated by ARCo for owner Robert Tyrrell. During 1992, Lindsey Walton sold his Corsair to the Erickson Aircraft Collection; a quarter of a century on, John flew it again in Oregon. And Spitfire PRXI PL983, the object of his attentions at Old Warden in the 1960s, has been a flying part of the ARCo stable since 2018.

Yet there are still fresh pleasures to be had. In New Zealand earlier in 2024, John got some stick time in the latest Mosquito to be restored by Avspecs, the T43 for Lewis Air Legends, while it was being flown by Steve Hinton. "That", he enthuses, "was one thing I'd always wanted to do". New engineering challenges, too, on the myriad projects ARCo has on the go for itself and outside clients.

Perhaps the biggest change of the past few years, though, has been the advent of passenger rides in warbirds under the SSAC — Safety Standards Acknowledgment and Consent — regulations. It's led to ARCo setting up its own in-house flight experiences operator, Aerial Collective, and such is demand that it's virtually a year-round undertaking. At a time of endlessly rising costs and regulatory burdens on both the maintenance and

LEFT:
Briefing for a Flying Legends Spitfire sequence with fellow Duxford warbird regulars including Historic Flying's hangar manager Martin Overall (right) and Brian Smith.
HARRY MEASURES

RIGHT: Lysander V9312, which returned to airworthiness in 2018, is the only airworthy British-built 'Lizzie'.
GEORGE ROMAIN

operational sides of the house, it came at the right moment.

"To adapt to all of that, certain things have helped tremendously, and one of those is SSAC", comments John. "I'd been fighting for the ability to take people in these aeroplanes for 20 years — when Rod Dean was at the GAD [the General Aviation Department of the CAA] I wrote a paper purely for him to present — because I always knew that if we could do that, it would give the aeroplanes accessibility to the general public. The general public then would see them in a different light, so we would get better adherence from people for what we were doing. It wouldn't be seen purely as rich boys with toys, which it was, and in some cases still can be. That money would enable us to operate certain aeroplanes for better longevity, and that's exactly what's happened.

"I know there are others doing it, and their businesses are different to ours, but that money enables us to fly things like Blenheims, Lysanders, MkXIs and do all the things we do. It's not all on the back of SSAC, but there is a chunk that is. Without SSAC and that money coming in, we wouldn't be flying the Blenheim. It costs a fortune to fly the aeroplane. With that and the maintenance we do, that's how we survive."

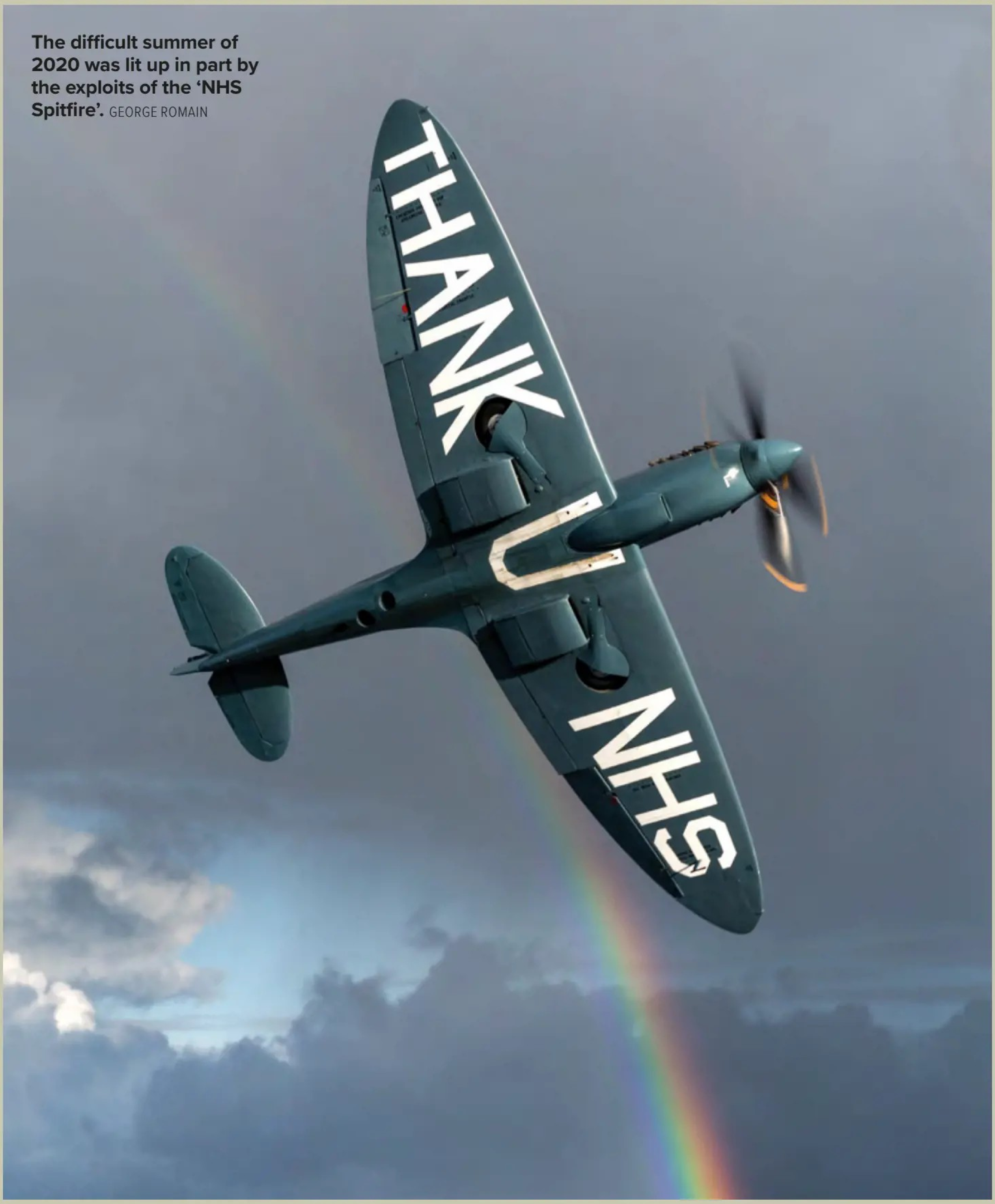
It doesn't help that there are now fewer airshows, with lower budgets, and thus less revenue to draw from them. "Trying to keep the aircraft sitting there, prepared and ready in case there is an airshow takes a long time and a lot of effort. Getting the piloting right also takes a lot of effort, because the new display pilot is a different person to those in the past. The ex-RAF-trained warbird people have gone, so we have to train in-house. You can only do that at a certain pace because you've only got a certain amount of time, but you've also got a certain amount of finance. To send someone off for half an hour's practice in a Spitfire costs a chunk of money, but you have to do it if you're going to keep on displaying those aeroplanes — and in particular when the CAA is manoeuvring the rules around all the time."

Years of display flying experience have imparted some very valuable lessons. "As I brief our pilots, if you're going to go out there and do it, then go out and do it well. Don't just go out and do it for yourself, and don't just go out and do it for the audience. There's a middle ground where you're actually doing it for the aeroplane. I remember Ray Hanna saying, 'Boys, don't kill yourself for the cost of an ice cream.' That's what it is. For some of the general public, you are competing against an ice cream.

"Equally, as well as the ice cream factor, there are also the 'ducks.' Over many years of seeing a lot of unfortunate accidents, it's never normally one big thing that hurts people. It's a multitude of small things. We call those the ducks. The ducks are going to peck you to death — it won't be the one crocodile that gets you. You have to identify your ducks leading up to you getting in the aeroplane. Everyone's got their own quantity they can cope with, but you need to identify that quantity… Once you've reached that number, back off. Say you need an hour away and come back and revisit it. If that means losing your slot, and not flying, so be it. You have to walk away. And on a film we're still involved in, we used the same thing to look after ourselves and others."

In one sense it's a world away from those early days at Duxford in the 1970s, setting up a cold, basic workshop with whatever came to hand. Yet if much has altered over the intervening decades, there's a great deal of continuity, too, not least in terms of John's determination, drive and ability. And the sheer pleasure derived from the end product still underpins it all. "When I can be myself in an aeroplane and just sit and relax and go off and fly it, I hope in a good way, there's the satisfaction."

To book a warbird flight experience with Aerial Collective, visit aerialcollective.co.uk



The difficult summer of 2020 was lit up in part by the exploits of the 'NHS Spitfire'. GEORGE ROMAIN

RHAPSODY IN NHS BLUE

The day before John's 60th birthday in August 2019 brought, alas, no cause for celebration. En route to a show in the Netherlands, Spitfire PRXI PL983 suffered a landing mishap at Midden Zeeland. The undercarriage having not been fully locked, it ended up on its nose, and had to be taken back to Duxford by road. However, the incident rather proved to be a blessing in disguise.

"The aircraft was in the hangar under repair", says John, "and then COVID hit. We were also at that time working some MoD contracts, and that meant we could have a minimal work crew in... I said to 'Mo' [chief engineer Martin Overall] and the others to finish the MkXI, because why not? Everything else had got to stop. It was finished with everything still in lockdown, but every Thursday night there was the 'Clap for Carers' going on in the streets. We were then up for air-testing it, and we had clearance from the CAA that we could air-test, but the restrictions on where and how were that it could not go any further than 10 miles' radius from its base, and it was only for testing.

"We launched on a Thursday afternoon [7 May 2020]. I live just over the hill [to the south of Duxford], and within that radius I brought it over the village, because everyone was outside clapping. People said it was nice to see, because it had been a long time since they'd seen anything like that. Landed back here, job done. Then the 'phones started ringing. 'That was so good, would you do it again?' We thought, yes, we could. The following Thursday we picked up two or three villages.

"Later we were sitting at home and my son said, 'Dad, we could do Addenbrooke's Hospital, couldn't we?' Yes, we could — why? He said he'd been thinking we could put 'THANK U NHS' under the aeroplane and fly past Addenbrooke's, because it was within 10 miles. I was wondering who could paint that on it, because everyone was still away.

"I walked in two days later and someone said, 'Have you seen the XI?' What do you mean, have I seen the XI? What have you done to it? 'Go and have a look'. George [John's son] and some others had been in and there it was, underneath the wings. OK, I guess we're going over Addenbrooke's, then... We called Addenbrooke's and said this was what we were thinking of doing, and they said it would be lovely, we should go for it and they'd let people know. We did that, came back here and landed.

"Afterwards the NHS called us and said the response had been tremendous. They asked if there was any chance we could do a bit more, once we were released. We had a think about that, and George's girlfriend Lucy, who's a brilliant marketeer, had all the right contacts in all the right places... She linked with the NHS and asked for a list of the major hospitals that were dealing with COVID, because not all were. We got the list, looked at it, and as soon as we were released in terms of distance we set up planned routes taking in as many as we could. We did the first two, and it went viral.

"We had literally hundreds of 'phone calls and e-mails from people who wanted to support it financially. We said no, we have to keep it clean. As soon as we start taking money, whatever's going to happen in the future somebody would say, 'I paid for that'. But because the requests kept coming, we went to the NHS and asked them to declare a charity. They suggested NHS Charities Together, and we put it up on JustGiving. As long as the donation was beyond £10 to the charity, we would write a name on the aeroplane in recognition of their donation to the charity."

The 'NHS Spitfire', its PR blue colour coincidentally appropriate, visited 220 hospitals and generated nearly £200,000 for health service charities. The award of MBEs to John and his wife Amanda — who wrote all the names on the Spitfire, over 6,000 of them — was suitable recognition for a splendid effort, and a wonderful piece of positive publicity for historic aviation.

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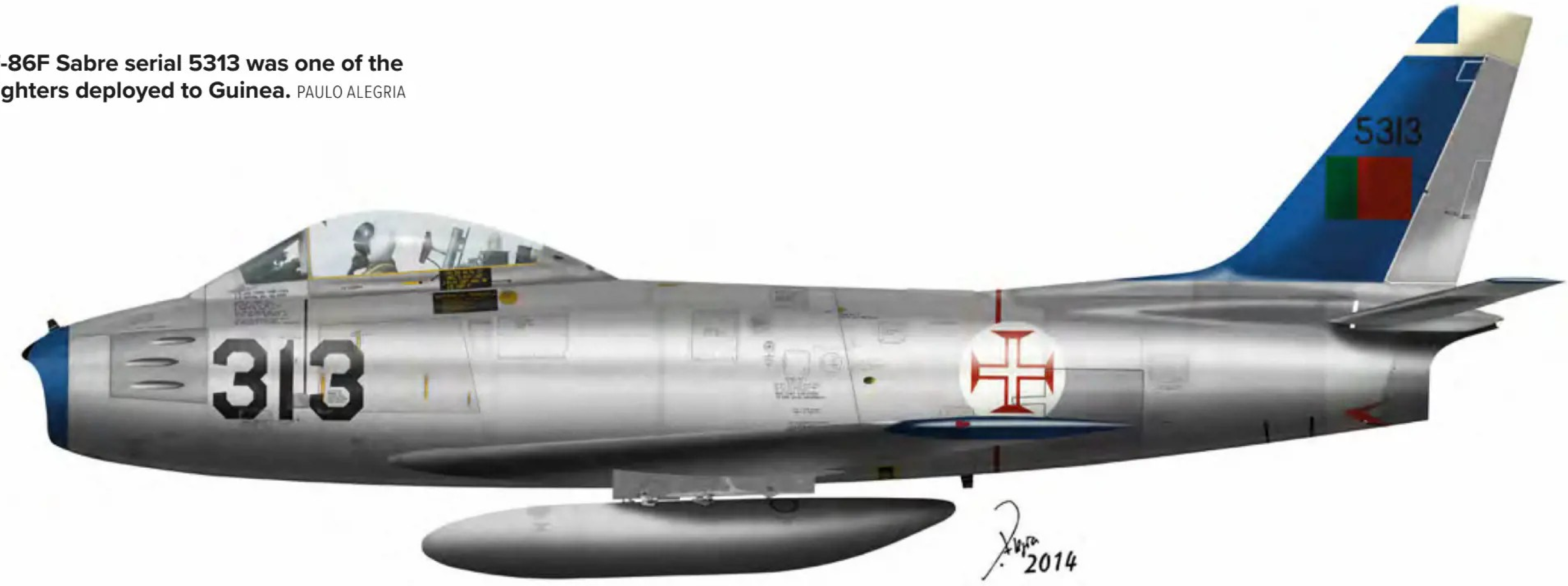


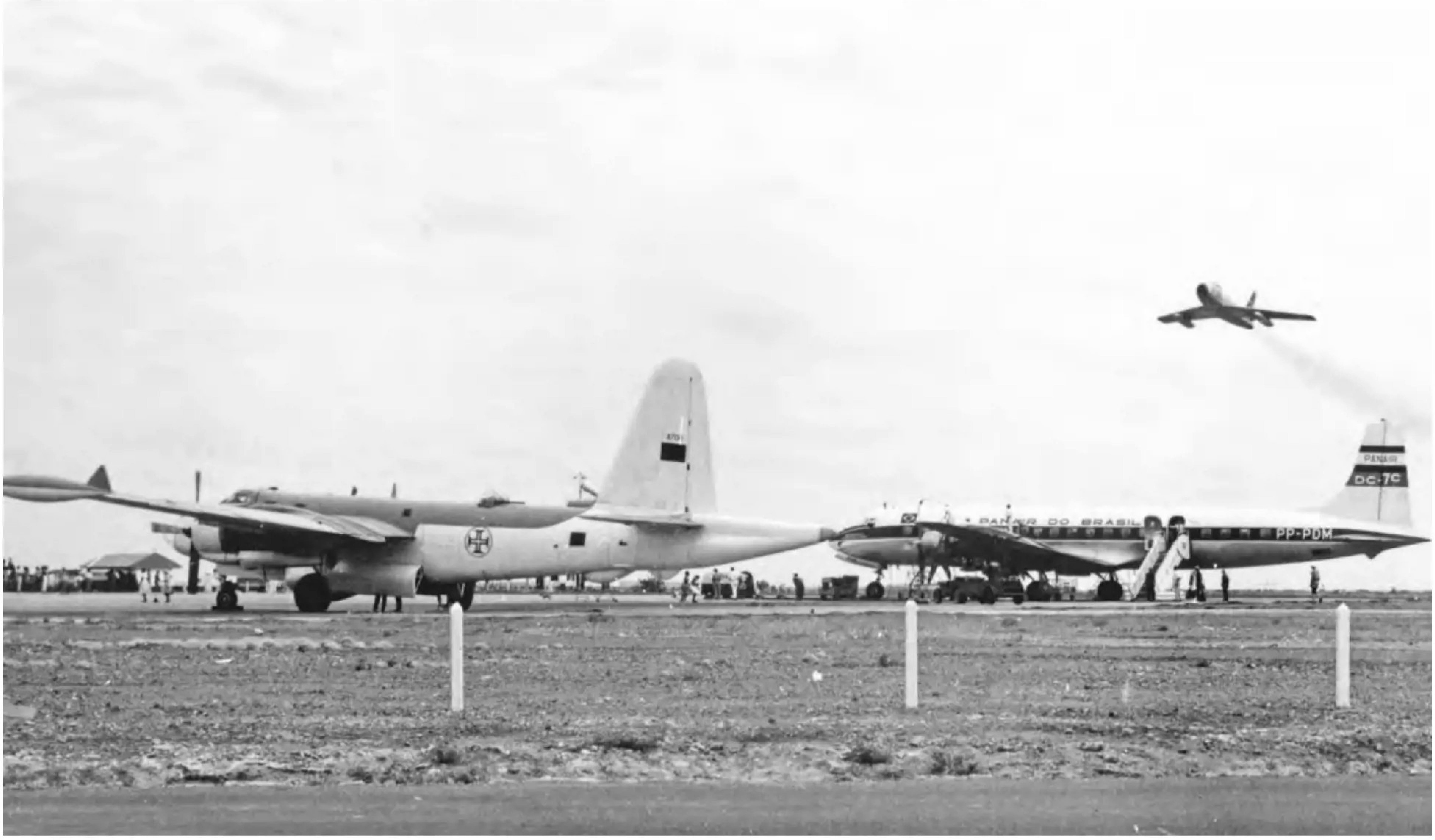
F-86F Sabre serial 5313 was one of the fighters deployed to Guinea. PAULO ALEGRIA

DOUBLE-EDGED SWORD

When the Portuguese Air Force deployed eight F-86F Sabre fighters to Bissalanca airfield in Guinea, ready to respond to the guerrilla movements beginning to emerge in that African territory, the political risks were considerable — and, in the end, insurmountable **WORDS:** JOSÉ MATOS

In the context of the former Portuguese colonial empire, the territories of Guinea and Cape Verde played a central role in the maritime and air routes connecting southern Africa, where Portugal had two important colonies: Angola and Mozambique. What's more, on the island of Sal in Cape Verde, the Portuguese Air Force had an airfield, designated AM1, it could use for maritime patrol missions allowing control over the Atlantic. Keeping these areas under Lisbon's rule was essential to wider colonial strategy, hence the swift reaction by the Salazar government when, in July 1961, the first attacks took place in northern Guinea, led by the MLG — Movimento de Libertação da Guiné, or Liberation Movement of Guinea — based in Senegal. This nationalist group targeted settlements in the north, near the Senegalese border. It led the government in Bissau to deploy military personnel to the affected areas, which seems to have deterred further MLG strikes. However, it was a sign that a guerrilla conflict was about to begin, which led the Portuguese Air Force to

In their dispersal at Bissalanca sit Sabres 313 and 317. FAP

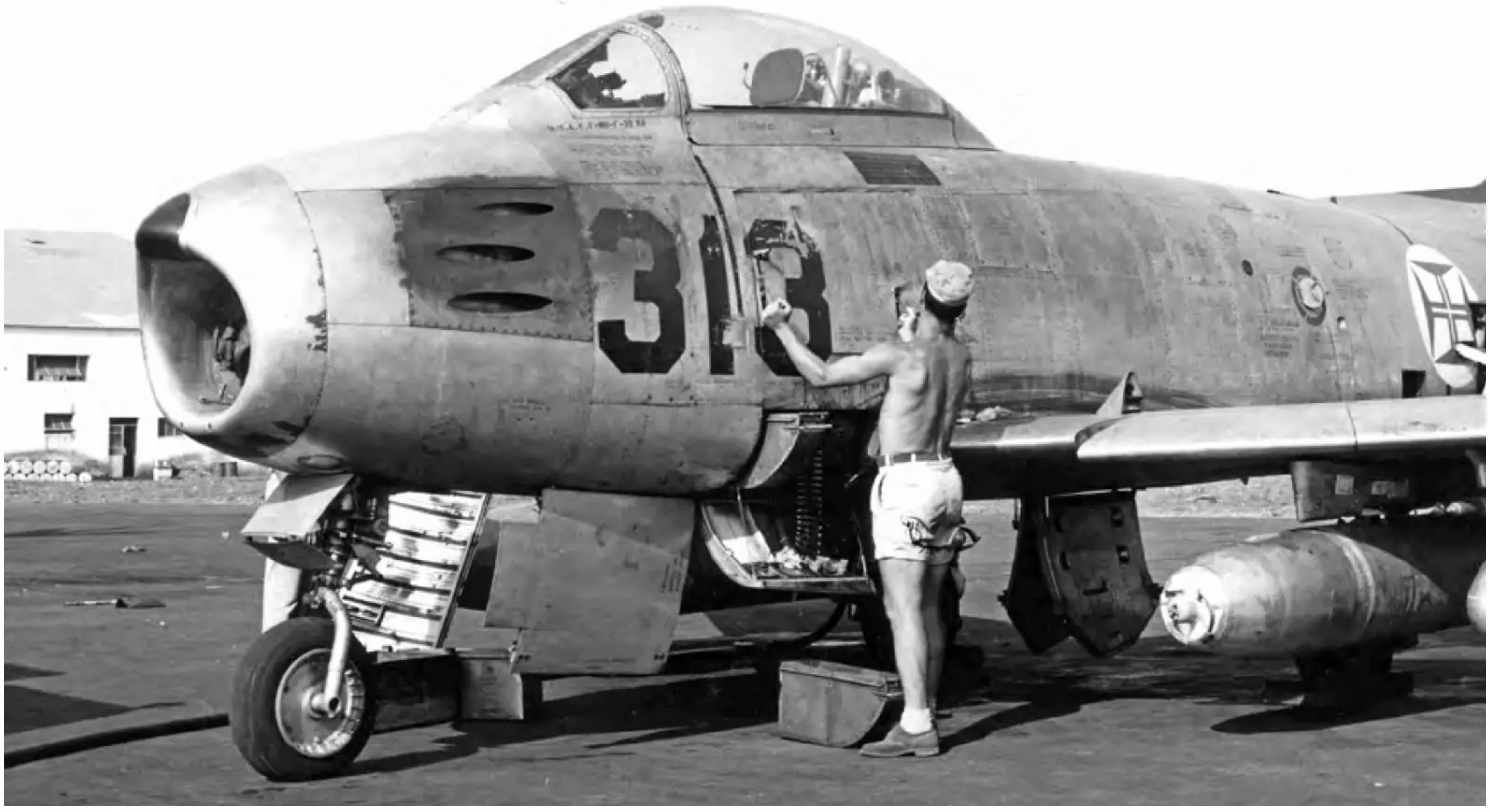


ABOVE: Typically for the diverse scene at Sal, an overflying Sabre passes above FAP P2V-5 Neptune serial 4706 and DC-7C PP-PDM of Panair do Brasil. TOURICAS COLLECTION

detach eight North American F-86F Sabres from Esquadra 51 'Falcões' at Monte Real air base.

Before this, the air force (FAP, Força Aérea Portuguesa) had no air assets in Guinea, nor any support infrastructure at Bissalanca aerodrome (AB2), about 10km north-west of Bissau. In 1961 this small facility had, in addition to the civil terminal, a hangar still under construction and no based aeroplanes. The only military aircraft passing through the Guinean capital once a week was a P2V-5 Neptune maritime patroller usually stationed more than 500 miles away on Sal. The actions of the MLG in the north of the colony led Portugal to strengthen its aerial presence in Guinea, the Sabre deployment being the most significant measure. The jets with the lowest likelihood of serious unserviceability were chosen, as well as those with the highest potential flight hours before their next major inspection, to keep them operational for as long as possible.

The F-86 had not been the first choice on the part of the 1st Air Region, which included Guinea. Its commander, Gen Machado de Barros, initially wanted F-84G Thunderjets to be sent to AB2. The order to despatch eight jets was



RIGHT: A groundcrew member attends to Sabre 313, with the ammunition bay open. FAP received at their Ota base by Capt Gomes do Amaral, who began readying the aircraft for a direct flight between mainland Portugal and Guinea. But with the start of the war in Angola, the F-84s were detached to Luanda, and it was decided to use F-86Fs instead. So it was that, at Monte Real, preparations began for the 2,000nm transit flight under the codename Operation 'Atlas.' The air force general staff stated that the fighters should leave from Montijo air base near Lisbon, with intermediate stops at Gando in the Canary Islands and Sal island in Cape Verde.

The 10 Sabres — eight primary aircraft plus two reserves — took off from Monte Real on the morning of 8 August 1961. Underwing they carried two each of 120 and 200-gallon tanks, affording maximum fuel capacity. The F-86s spent a day at Montijo, being visited on the morning of 9 August by the Secretary of State for Aeronautics, Col Kaúlza de Arriaga, accompanied by the base commander, Col Rodrigues Frutuoso.

Then the eight fighters assigned to the mission in Guinea took off for the 722nm stretch to the Canaries, arriving at Gando. The pilots spent the night at the Spanish base, departing the next day for the second part of the trip to Sal, involving another 800nm flight over the ocean. Maintaining the same speed and altitude regime used on the leg to Gando, the fighters reached Sal after two hours 27 minutes in flight. It had been trouble-free, and they were made ready for the final stage to Bissau, a distance of 526nm. A sudden outbreak of bad weather in Cape Verde — where it hadn't rained for seven years — delayed their departure. When conditions improved on 15 August, it was possible to embark on the last sector, arriving in Guinea in a flight time of one hour 17 minutes. It could hardly have gone more smoothly.

> *"The major problem was the lack of facilities at the base"*

Eight pilots were chosen for this inaugural detachment: four officers and four sergeants, under the command of Capt Ramiro de Almeida Santos. Joining him were Capt José Almeida Brito, Lts Aníbal Pinho Freire and Alcides Teixeira Lopo, and Sgts José Pombo Rodrigues, Rui Salvado da Cunha, António Rodrigues Pereira and Humberto Cartaxo da Silva. Each group stayed for three months before being replaced, a rotation which provided the men from Monte Real with important experience in an African theatre. In operational terms, the Portuguese fighters could execute tasks including air defence, air support to ground forces and visual reconnaissance missions, in addition to the deterrent presence they exerted depending on the available firepower and the speed with which they could reach any point in the territory.

The early days of the F-86s in Guinea were relatively peaceful, the aircraft performing visual and armed reconnaissance sorties over the colony. The major problem faced was the lack of facilities at AB2, which was still being built up in readiness to receive new air assets. This can be ascertained from the first reports the detachment commander sent to Lisbon. Ramiro Santos mentioned how the runway was very dirty and covered

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5354
TAP

As F-86F 354 taxies at Sal, so an L-1049G Super Constellation of Portuguese national carrier TAP runs up its engines. FAP

ABOVE: The FAP maintained a Neptune deployment to Sal, joined from late 1961 by Sabre detachments.
TOURICAS COLLECTION

in stones, and hard to clean due to the absence of a mechanical brush. The apron could not withstand the corrosive nature of the JP-4 fuel used by the Sabres and the aircraft were refuelled from drums, which made the operation very time-consuming. The UHF communications equipment in the control tower did not meet the deployment's needs and air traffic control was very poor; there was no meteorological service and the runway presented safety hazards with people and animals crossing it.

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The first F-86 flights in Guinea took place on 19 August. During one of the early sorties, performed by Lt Teixeira Lopo and Sgt Cartaxo da Silva, Lopo's Sabre suffered a major birdstrike, leaving the canopy stained with blood and causing damage to the horizontal stabiliser. This left serial 5361 out of service for several weeks until the arrival at AB2 of a new tail ordered from Monte Real. The next day, Capt Almeida Brito and Sgt Rodrigues Pereira flew low over the city of Bolama during a visit by the governor and commander-in-chief of Guinea, Cdr Peixoto Correia, after Brito's aeroplane had made three failed attempts to start. The Portuguese fighters carried out several reconnaissance flights over the months that followed, mainly in the northern region, although poor maps made flights in the border area tricky due to the risk of violating Senegal's airspace.

October 1961 saw two F-86s detaching to the strategically important island of Sal, but it also brought the departure of Detachment 52's first group of pilots. They bade farewell with a six-ship formation aerobatic display above Bissau, and an overflight of the city by Lopo in serial 5322 during which he broke the sound barrier. The second cadre of pilots took over at Bissalanca at the end of the month, thus continuing the F-86s' mission in a territory where war had not yet broken out.

So-called 'sovereignty flights' formed the majority of missions in 1962, alongside the regular pilot rotations from Monte Real. However, on 17 August, an accident involving an F-86 caused its loss. It happened when Capt Gomes do Amaral and Lt Amilcar Barbosa were surprised by a heavy downpour over AB2 on their return to base. Due to poor visibility, Barbosa made several approaches and eventually landed in the final third of the runway. Leaving the runway, the Sabre hit some muddy mounds and was thrown sideways. When the emergency services arrived they found the aircraft without its pilot, who had already climbed out suffering only slight abrasions.

All the while, in Guinea-Conakry the PAIGC (Partido Africano para a Independência da Guiné e Cabo Verde, or African Party for the Independence of Guinea and Cape Verde), led by Amilcar Cabral, was conducting subversive activity and preparing for an armed struggle. It began on 23 January 1963 with a dawn attack on a barracks complex at Tite, very close to Bissau, led by 15-20 PAIGC elements. One Portuguese soldier was killed and two wounded. The guerrillas kept the barracks under heavy fire for half an hour and suffered three casualties of their own. The skirmish symbolically marked the start of the war in Guinea.

Portuguese forces were ambushed in the Buba area of the Fulacunda region that night, losing two soldiers. Four days later, another guerrilla attack in the same region caused two more Portuguese casualties and injured four. Portuguese troops recorded the first ambushes in the Bedanda region of southern Guinea later in January, and the guerrilla actions continued to increase in intensity as the months went by. While the PAIGC struck in the south of the colony, the MLG was operating in the north, hitting settlements and ambushing military vehicles.

As for the air force, it is not known exactly when the first offensive action was taken, but on 4 April an Auster observation aircraft was shot at with light weapons from the Darsalame tabanca — a tabanca being a settlement, usually fortified,

found in some parts of Africa. This led the FAP, the next day, to launch a demonstration of force against the village in question, using eight F-86Fs to bomb the vicinity. The Portuguese fighters were equipped with six 12.7mm-calibre Browning Colt TM3 machine guns and could carry various types of weaponry such as 2.75in rockets, 50 and 250kg general-purpose bombs and 350-litre napalm tanks. Back home in Portugal they also used AIM-9B Sidewinder air-to-air missiles for air defence purposes, but they were never carried in Guinea.

The governor of Guinea, Vasco Rodrigues, received a report from the Senegalese consul in Bissau on 9 April saying the Dakar station had reported four air force aircraft as bombing a Senegalese village near the border with Guinea that morning. Following the news, the commander of the Air Zone of Cape Verde and Guinea (Zona Aérea de Cabo Verde e Guiné, ZACVG), Lt Col Durval Serrano de Almeida, informed the military commander of Guinea, Brig Louro de Sousa that no FAP aircraft had taken off for 'hot' missions on the 9th. However, four aircraft — two F-86Fs and two T-6 Texans — had bombed the Bunhaque tabanca, very close to the Senegalese frontier, the previous day.

To find out what had happened, the ZACVG command sent an officer to the site, together with the officers involved in the attack. They reached the conclusion that it had in fact occurred on the Portuguese side and not the Senegalese one. The government in Dakar requested an urgent meeting of the UN Security Council, where it lodged a complaint against Portugal, giving rise to a motion which condemned any incursion by Portuguese military forces into Senegalese territory.

> **“*The FAP launched a show of force with eight F-86s*”**

The FAP lost another F-86 on 31 May when serial 5322, piloted by Capt Fausto Valla, was hit by shrapnel from a 250kg bomb it had just dropped in the Bedanda area of southern Guinea, near the Cumbijã River. Together with Sabre 5356 in the hands of 2nd Sgt Manuel Pereira Clemente, it had been conducting a shallow dive attack. Both were damaged and their pilots tried to return to AB2 with several holes in the fuselage, each still toting one bomb. Crossing the Geba River, Valla's F-86 suffered an engine flame-out and he was forced to eject under the watchful eye of Clemente. The aeroplane exploded on hitting the ground, although

LEFT: A small parade by FAP personnel on the Bissalanca tarmac, with a backdrop of Sabres, a T-6 and a C-47.

COR LOBO FERNANDES

the bomb it was carrying remained intact, later being disarmed. Clemente managed to land back at Bissalanca after dropping his bomb in the river.

An assessment mission led by the Secretary General of National Defence, Gen Venancio Deslandes, visited Guinea for a week in mid-May 1963 and analysed the military situation, producing a report for the minister in charge. Along with the main report there is one by Lt Col Augusto Brito e Melo which identified the main problems facing Portuguese forces in Guinea. From this it can be ascertained that the air force had seven F-86Fs, eight T-6s, eight Austers, three DC-3s, one Broussard and one P2V-5 at AB2.

The Sabre operation presented the most problems. The aircraft flew very little — just eight to 23 operational sorties per month — and all needed urgent replacement having exceeded the IRAN (inspect and repair as necessary) period by more than a year. They had difficulties communicating with ground forces as they could only use UHF, which made it impossible to talk to troops equipped with PRC-10 radios. Thus, the F-86s were only able to carry out pre-planned missions, leaving close support tasks to the T-6s with their minimal firepower and greater vulnerability to anti-aircraft artillery.

The Sabre airframes were very badly affected by damage to the runway and parking areas. The runway was being repaired, but the aprons couldn't be improved because the surface would always be harmed by the JP-4 fuel. Brito e Melo also pointed out that the F-86 pilots were well-prepared, but he had no doubt that if the sortie rate increased it would probably cause the AB2 maintenance system to break down. Not until July 1963 did eight replacement Sabres arrive at Bissalanca by sea to take over from those survivors from the contingent originally deployed.

Three months after Deslandes was there, the chief of staff of the 1st Air Region, Col Krus Abecasis, also decided to visit Guinea, and in particular the ZACVG. A subsequent report to the chief of staff on the situation of AB2's air assets and the base's operational activity, dated 14 September 1963, gives a good overview of the Sabres' state of readiness. With 14 pilots to fly them, the eight fighters deployed to Bissalanca were generally mission-ready, although one was about to reach its IRAN deadline and only four had VHF radios, limiting the ability to contact ground troops to half the aircraft available. Although the condition of the airframes was felt to be fairly good, problems were already beginning to be detected with the internal armament, which was in a poor state. This was put down to factors including "improper use by some pilots" and "less careful maintenance". Inspections after every 25, 50

Sabre 354 on exuberant form at Sal, while two deployed Neptunes are serviced on the flightline at this island base. TOURICAS COLLECTION

354
307
35
326
362

and 100 flying hours were carried out locally and maintenance was of an appropriate standard.

By now the presence of the F-86s in Guinea had become a cause for concern in the US State Department, which did not want to see equipment provided under the Military Assistance Program being diverted to Africa. Pressures were beginning to emerge for the aircraft to return to Portugal, and the issue dragged on throughout 1963 without the American demands being met.

The Portuguese foreign minister, Franco Nogueira, had a long conversation in June 1964 with the US ambassador to Lisbon, George Anderson, during which it was again addressed. Nogueira said the F-86s were not conducting operations in Guinea, instead serving only as a deterrent against possible air attacks from neighbouring countries. Anderson agreed with the argument, but felt no foreign air attack was to be expected and that, "in the event of such an attack, a new political situation would be created which would change the [basis] of the problem, even for the United States". Nogueira then asked whether "Washington would take an active stance against an air attack from outside", to which the American ambassador replied, "he could not predict how his government would react, let alone make commitments". Anderson insisted the problem of the F-86s in Guinea "was a matter of principle" and that it was a subject much exploited by Portugal's enemies, to which Nogueira commented that there must have been many in the State Department, "because they all seemed to gauge the United States' policy towards Portugal [by] what happened to the F-86s."

Shortly after this meeting, American pressure increased to such an extent that Washington refused to provide spare parts to the FAP if the Portuguese did not withdraw the fighters from Guinea. Lisbon eventually gave way, causing great concern to the new commander-in-chief of Guinea, Brig Arnaldo Schulz. In a letter to the Minister of Defence, Gen Gomes de Araújo, he stressed the air force's importance in the Guinean war and the lack of support for ground troops. Were it not for the Sabres, they would become completely dependent on T-6s, "which are increasingly vulnerable in the face of the constant improvement of the enemy's anti-air resources and even then [are available] in insufficient numbers" — just five were operational.

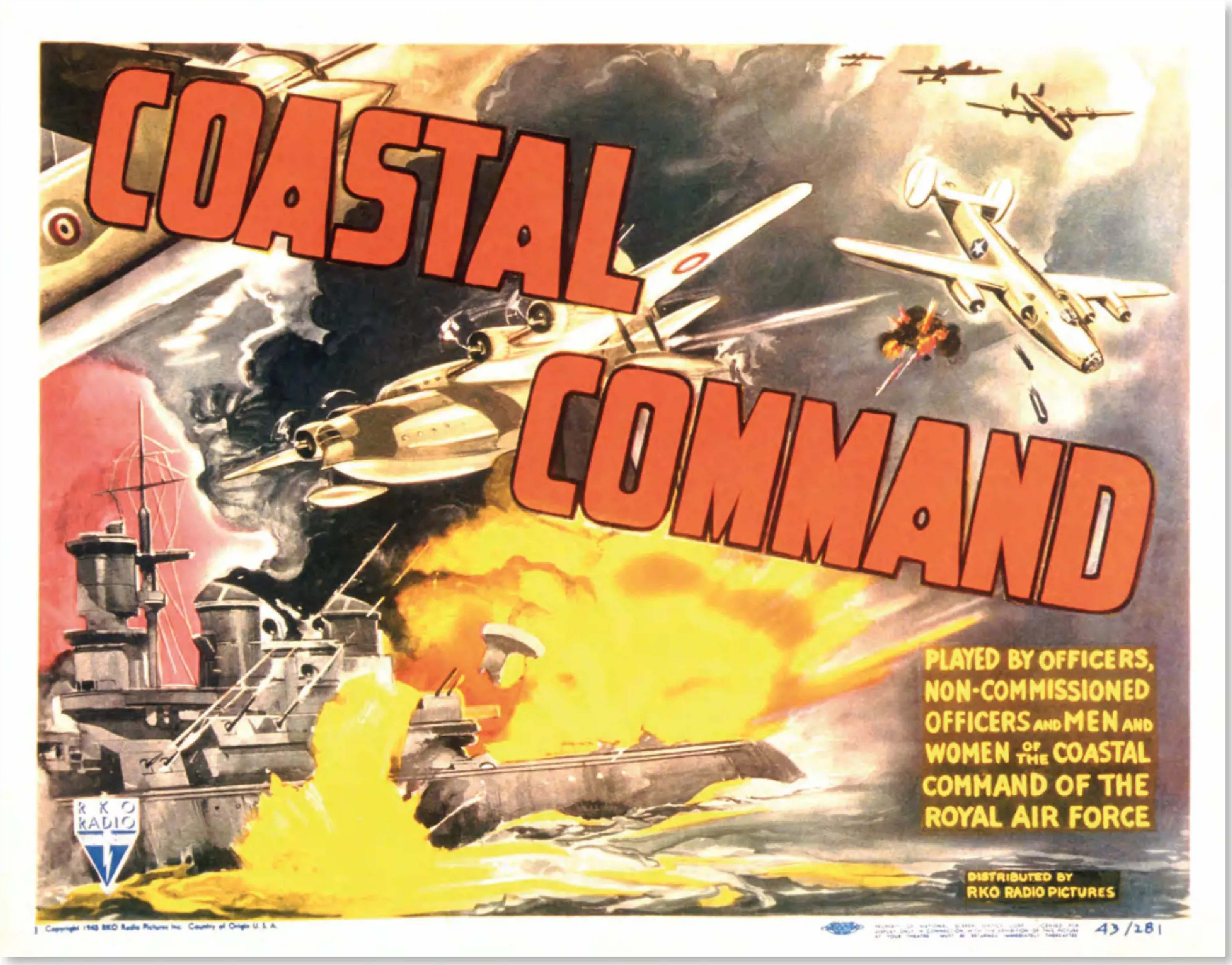
Gomes de Araújo explained to Schulz the real reason for the withdrawal when he said, "the Americans are now refusing to sell us the spare parts for these aircraft (F-84 and PV-2) and any other materiel. They are even refusing any kind of negotiations while we keep the F-86s in Guinea". Faced with this, the minister saw only two solutions: "the first would be to keep the F-86s there, because they would certainly not go there to seize them; but this situation eliminates any kind of understanding in relation to all the other materiel, especially the F-84, PV-2 and DC-6, which would soon be immobilised; the second is the withdrawal of the F-86s from Guinea, an attitude which opens the door to negotiations..."

To compensate for the loss of the Sabres, the minister proposed several alternatives. One was to reinforce Guinea with T-6s and PV-2s from units based in Angola. Another was to rapidly seek more F-86s on the market and, if that was impossible, to transfer F-84s from Angola to Guinea. Gomes de Araújo wrote to the commander-in-chief of Angola, putting forward that idea. The minister's decision was analysed by the commander of the 2nd Air Region in Luanda, who was firmly against it. Alternatively, the Portuguese government was trying to buy a batch of Canadair Sabre 6s from West Germany's Luftwaffe, but the deal was vetoed by Canada due to US influence. Faced with this, West Germany offered a batch of Fiat G91R/4s, which proved more suited to the kind of guerrilla warfare taking place in Africa.

Even so, the deployment of the F-86Fs from Monte Real to Guinea was a success, despite the difficulties of flying from an airfield still in the build-up phase. The initial objective was to act as a deterrent to insurgents, which the Sabres carried out throughout the colony before going on to fly combat missions at the start of the war. Over the three years they spent in Guinea, pilots and technicians gained experience in an African war environment, which proved useful for other combat operations in Portugal's former overseas provinces. However, the use of NATO assets outside the geographical limits of the Atlantic alliance contained high political risks, which eventually manifested themselves in the fighters returning to Portugal. Everything comes back to politics, one way or another...

ABOVE:
Colour images of the Guinea deployment are very rare. Six of the Sabres are followed in the line-up by a pair of shark-mouthed T-6s, as used in the close support role.
TGEN JOSÉ NICO

"One of the finest films of the war"

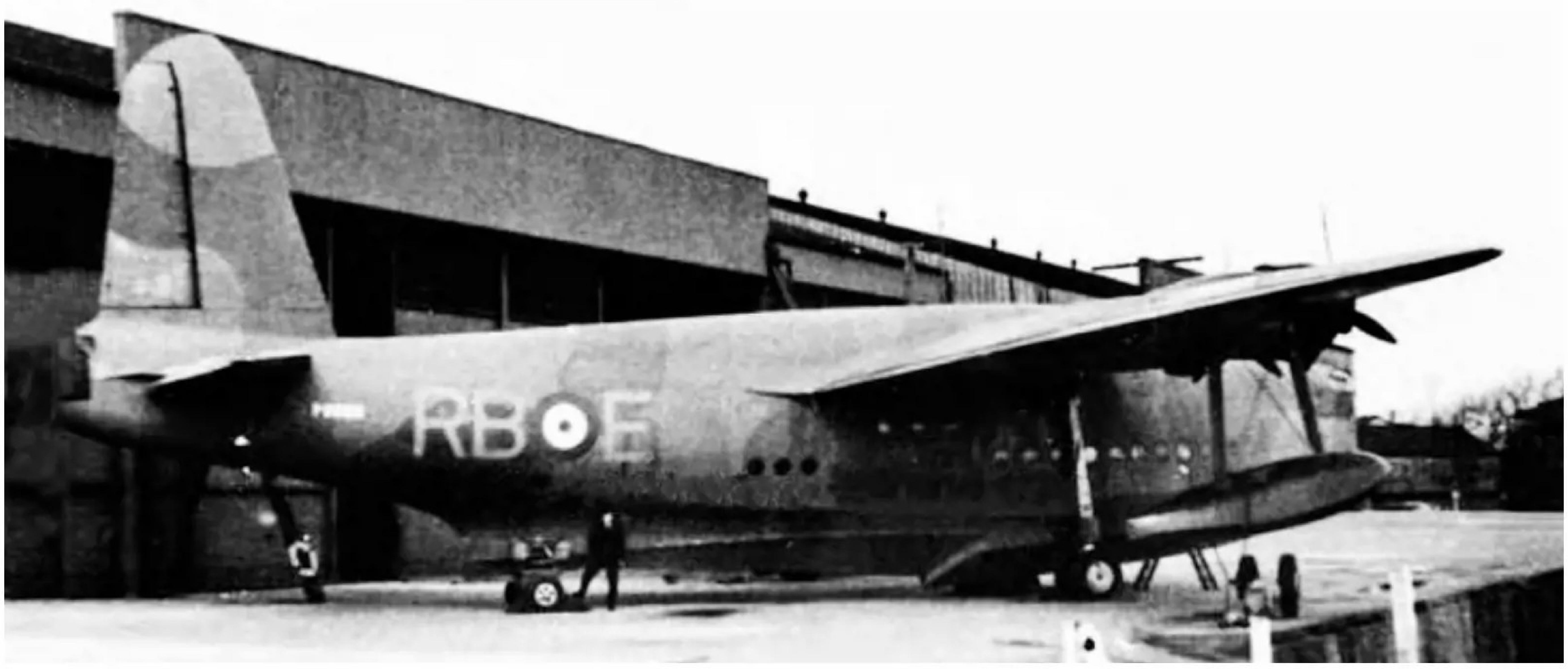

COASTAL COMMAND
PLAYED BY OFFICERS, NON-COMMISSIONED OFFICERS AND MEN AND WOMEN OF THE COASTAL COMMAND OF THE ROYAL AIR FORCE
RKO RADIO
DISTRIBUTED BY RKO RADIO PICTURES
Copyright 1943 RKO Radio Pictures Inc. Country of Origin U.S.A.
43/281

GETTY

That was the verdict of one paper on *Coastal Command*, which portrayed so vividly the activities of crews and aircraft engaged in the Battle of the Atlantic — using those actual men and machines **WORDS:** JOHN EVANS

On an October evening in 1942, high-ranking RAF officers mixed with invited guests at the Plaza Theatre in London's Piccadilly Circus for the premiere of the Crown Film Unit's latest offering, *Coastal Command*. Following on from the unit's acclaimed *Target for Tonight*, it had a similar format. Instead of Vickers Wellington 'F for Freddie' and its Bomber Command crew, Short Sunderland 'T for Tommy' and those who operated it were the aeronautical stars. For some this was a painfully moving and bittersweet moment, as the characters on screen were their relatives who had died in the crash of a Sunderland just weeks earlier, one which also claimed the life of a member of the Royal Family.

Although numerous types of aircraft operated by Coastal Command take their place in the spotlight, the main focus revolved around the Sunderland and its crew based at a Scottish flying boat station, Port Ferry Bay — in reality, Bowmore on



LEFT:
Sunderland I P9600 during its time with No 10 Squadron, RAAF — a unique Australian unit in spending the whole war in Europe.
PERCY SMITH COLLECTION

Islay. An evocative insight was provided into the day-to-day roles and challenges for flying boats in the harsh maritime environment, very different to those in Bomber and Fighter Commands. Its timing coincided with a critical period in the Battle of the Atlantic and the ceaseless war against the German Navy's warships and submarine fleet, and it heightened the public's awareness of what the men of Coastal Command were facing daily in the maritime war.

All who took part were serving members of the RAF — there were no actors. These included the commander-in-chief of Coastal Command at that time, ACM Sir Philip Joubert de la Ferté and Gp Capt Gerry Livock, seen in the HQ operations room. Livock was a legendary flying boat man, one of the pilots from the 1927 Far East Flight when four Supermarine Southamptons staged to Singapore, opening air routes to the Far East and Australia for the first time.

Key members of the Crown Film Unit team were director Jack Holmes and senior cameraman Jonah Jones. As late as September 1942 the film was still being referred to in some correspondence with the title *We Search And Strike*, but it was launched as *Coastal Command*. The picture — reportedly costing nearly £16,500 to make instead of the initial budget of under £9,000 — went on general release in mid-November 1942 and distribution in the United States was from February 1943. Several sets were constructed at Pinewood Studios, including the barrack room setting for the concert hall performance by wartime entertainer Ralph Reader and his Gang Show. It was during the show that the crew of 'T for Tommy' were called to action.

They were mostly drawn from experienced members of No 228 Squadron, RAF, one of the first to receive the brand-new Sunderland in 1938. 228 had led a peripatetic wartime existence, operating in UK waters and the Mediterranean, including the ill-fated Greece and Crete campaigns. After dallying with West Africa, 228 began re-forming at Stranraer in the autumn of 1941, building up its strength.

> ***"It heightened awareness of what Coastal Command was facing"***

Sqn Ldr Joe Grunert's crew formed the basis of the film crew, but he was not to be the captain of 'T for Tommy'. However, Grunert played his part, piloting the second Sunderland from which much of the filming took place, and on 2 January 1942 he married his fiancée Mary King in the Round Church, Bowmore, with his crew forming the guard of honour.

Captain of the aircraft was Wg Cdr Ernest Leslie Hyde who had already completed a tour with No 204 Squadron and was a holder of the Distinguished Flying Cross. Known as 'Johnny', he had flown Sunderlands since before the war. In October 1939 he had — along with his 12-man crew — been rescued after their Sunderland, N9045, ditched after running short of fuel. The aeroplane was lost. Fifty years later, one of his 'T for Tommy' crew, Peter Moon, recalled Hyde very well. "None of us knew Johnny Hyde until he joined us for the film and we soon fell under his spell", he said. "He was a splendid officer and a very able skipper."

First pilot Fg Off Robert Briscoe — known by others on No 228 Squadron as 'Sean' — was a survivor of a Sunderland crash during the Greece campaign. In April 1941 he was with Flt Lt Henry Lamond's crew, involved in evacuation flights from locations in the Greek islands. Aboard Sunderland T9048 they had made two dangerous sorties from Kalamata on the 25th. That evening Lamond was ordered to return to Kalamata to deliver a message to a senior RAF officer. With only the landing lights to assist, the Sunderland attempted to touch down but broke up and only four survived: Lamond, Briscoe, second pilot Bill Goldfish and Sgt Danny Davies. Briscoe was taken to a nursing home and

LEFT:
No 209 Squadron's Sqn Ldr Eddy Edwards standing in the port blister turret of a Catalina.
EDWARDS COLLECTION

evacuated to safety but the other survivors, in a military hospital, were made prisoners of war. After the filming Briscoe returned to No 228 Squadron and was the captain of a Sunderland which attacked a submerging U-boat on 23 May 1942.

Of the other regular members of 'Tommy's' crew, Charles Lewis from Letterston in Pembrokeshire had flown on bombing operations with No 51 Squadron in Armstrong Whitworth Whitleys. On the day war was declared, Lewis was in Fg Off Milne's crew in Whitley III K8938 which made an eight-hour operational flight from Leconfield, his logbook recording, "distribution of peace pamphlets Bremen-Hamburg-Berlin". Lewis was then posted to No 210 Squadron on Sunderlands at Pembroke Dock, and cross-posted to No 228 Squadron in 1941.

He and fellow Welshman Royston Jones from Aberavon were very good friends, along with Ernest (Teddy) Hewerdine, who hailed from Lincolnshire. They had shared various adventures with the squadron. Jones was known by his 'last three' RAF number, 'Jones 047', as there were so many Welsh airmen on the unit!

Others who made up the original crew included Plt Off 'Tammy' Morton DFM, Flt Lt John Mason (the squadron gunnery officer), Flt Sgt Peter Moon, Sgt Israel and Cpl James Munday. Reg 'Pam' Barton DFM also featured, dramatically crawling inside one of the wings to plug holes in a fuel tank following an attack by Luftwaffe Junkers Ju 88s, and getting soaked in fuel in the process. Close scrutiny of the dialogue will note that most are referred to by their actual surnames or nicknames, but Wg Cdr Hyde is known as 'Campbell'. When ashore he has a little dog following him around.

RIGHT: Charles Lewis wielding a Vickers machine gun.
LEWIS FAMILY COLLECTION

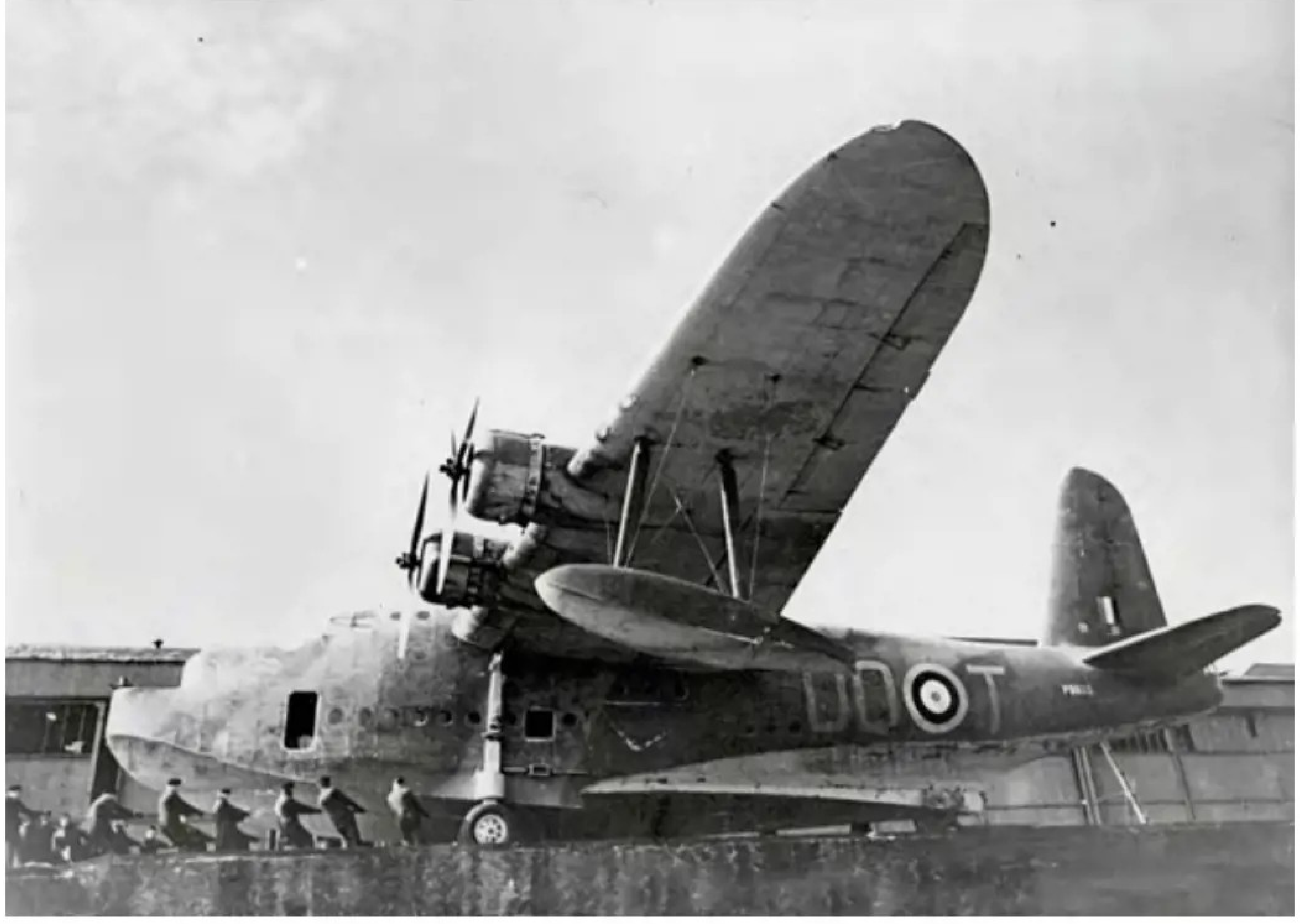
At least four Sunderlands appear in *Coastal Command*, one very briefly. Most prominent is P9600, one of a batch of MkIs delivered by Shorts' Rochester factory between September 1939 and April 1940. It served with No 210 Squadron, RAF, and the first Royal Australian Air Force flying boat squadron, No 10 Squadron, before joining No 228 Squadron in early December 1941, in time to appear on camera.

Logbook entries by Peter Moon, who retired as a group captain, for December 1941 and January 1942 record that he made 20 flights in P9600 totalling in excess of 28 hours for filming purposes, operating from Bowmore with Hyde and Briscoe at the controls. On 16 December a 50-minute sortie was also made searching for a Fleet Air Arm Fairey Albacore, without success. The longest flight was on 20 December: six hours 40 minutes for "convoy shots". And on Christmas Day P9600 was airborne with Briscoe at the controls to fly Moon and Morton from Bowmore to Stranraer.

After its film role this veteran MkI joined No 4 Operational Training Unit and survived the attentions of a succession of fledgling flying boat crews who gained experience on type before joining squadrons. P9600 was one of very few Sunderland Is to survive the war and could have been a candidate for preservation, but this was not to be. It was struck off charge officially in December 1946.

Charles Lewis's logbook records 25 flights in P9600 during December 1941, beginning with a test flight on the 3rd before proceeding from Pembroke Dock to Stranraer the following day and to Bowmore on the 5th. Twelve flights were logged in January 1942 and five in February, though the final three were at RAF Mount Batten, Plymouth, the last on the 26th. There P9600 was brought up-slip for interior shots to be filmed. The intense filming period was over.

Also called up for film duty was another MkI from the same production batch, P9606. The photo archive of Sqn Ldr Eddy Edwards, who piloted a Consolidated Catalina used to record flying sequences, includes one of P9606 at Invergordon carrying the TA code letters of No 4 OTU. After operational service with No 10



RIGHT: P9600 was transferred to No 228 Squadron by the time filming began.
IWM

T9465
SPIRIT OF
LOCKHEED-VEGA EMPLOYEES

Well-known No 269 Squadron Hudson III T9465 *Spirit of Lockheed-Vega Employees* over the Icelandic coast. ALAMY

Squadron, RAAF and No 201 Squadron, this Sunderland took on its training role in December 1941, being struck off charge in May 1944.

The starring Sunderlands carried the code letters DO-T, somewhat confusingly as No 228 Squadron's codes at that time were prefixed DQ. It was no doubt convenient for the 'Q' to become an 'O', requiring minimal paint change. For one sequence, in which 'T for Tommy' encounters the Luftwaffe, a No 10 Squadron, RAAF aircraft — code letters RB-K — came to help. This was most likely P9605, again from the same production batch, which later joined No 4 OTU, surviving for another two years until being struck off charge in May 1944.

There is a cameo by L2160, the third production MkI whose rear Frazer-Nash gun turret can be seen. First flown in May 1938, L2160 briefly joined No 209 Squadron before being flown out to No 230 Squadron at Seletar, Singapore, where it was christened *Selangor* by the sultan of that state. With May 1940's German advances through western Europe, 230 moved to the Mediterranean and was involved in the Greece and Crete campaigns alongside 228. This front-line veteran survived to become another trainer at No 4 OTU, ending up as a ground instructional airframe.

Catalinas participated a good deal and played a vital function in the air-to-air filming. There are fine views of MkIb Z2141/QL-A from No 413 Squadron, Royal Canadian Air Force, obviously shot before 10 November 1941 when this aircraft sank at Invergordon. Also appearing was No 209 Squadron's WQ-N, serial unconfirmed, which first locates a 'German battleship', the *Düsseldorf*. This was an appropriate connection as one of the unit's Catalinas had, in May 1941, spotted the *Bismarck*, a sighting which ultimately led to its destruction by the Royal Navy. Catalina AH538 was employed as a camera platform.

> **"Most crew members are referred to by their actual surnames"**

Other types from Coastal Command's front line appear. There are fine action views of Beauforts and Hudsons, with take-off sequences and formations as they set forth to attack the *Düsseldorf*. A successful Beaufort torpedo strike and at least two bombs on target from the Hudsons cripple the German raider, which is later finished off by the Royal Navy. Close-ups of Beauforts and Hudsons sweeping very low over the heavily defended warship add a definite sense of dramatic realism.

Of the torpedo-carrying Beauforts, one has been

Wg Cdr Johnny Hyde DFC and Plt Off 'Tammy' Morton DFM. NO 228 SQUADRON ARCHIVES

Robert Briscoe (right) and Reg Barton. VIA ROBIN MONCUR

RIGHT: Very experienced Sunderland captain Johnny Hyde DFC was the captain of 'T for Tommy'. ROBIN MONCUR COLLECTION

identified as MkI AM234, coded TU-Z with No 1 Torpedo Unit, while a well-photographed Hudson, part of the formation from No 269 Squadron — like the Beauforts, based in Iceland — is MkIII T9465/UA-N. It carries the script *Spirit of Lockheed-Vega Employees*, a gift from the company and the workforce who made the Hudson in the USA. In the Icelandic views US Army Air Forces Curtiss P-40 Warhawks flying from Kaldadarnes are seen briefly.

In his book *Coastal Command Pilot*, Ted Rayner recalled his involvement in the film. Then instructing at Silloth, duties were interrupted by the call to provide nine Hudsons to fly a formation previously filmed against dramatic Icelandic scenery. Several of the pilots had little experience of formation work, but after half-an-hour's practice the nine aeroplanes wheeled about over the Solway Firth with some precision and the cameraman began to shoot. His camera was mounted on a Heath Robinson-esque tripod in the doorway of a 10th Hudson, the door having been removed, and the aircraft flew across and around the formation to get shots from all angles.

Later, Rayner and fellow pilot Johnnie Lane were tasked with creating detailed sequences of a Hudson diving, a stricken aircraft trailing smoke, and the underside of one as the bomb doors opened and a (mock) bomb was dropped. The two Hudsons flew only feet apart for the bombing shots and Rayner was relieved the film team were happy with the first take, meaning a repeat was not required. The smoke trail was created by an airman locked in the fuselage detonating a smoke canister, the red trails flooding out through the cabin windows. For the airman, the result was a red face and equally red hair.

There are also appearances by Luftwaffe Ju 88s, though one looks suspiciously and fleetingly like a Blenheim. As the film reaches its crescendo Sunderland 'T for Tommy' — hit by anti-aircraft fire sustained from a close pass of the damaged *Düsseldorf* — has a running battle with three Ju 88s. Help comes from the Australian Sunderland with fine views of both aircraft flying low over the water. A flight of Beaufighters muscles in to send the Junkers packing. The last shots of both Sunderlands are of them sweeping around Bowmore before landing in the twilight, appearing dramatically low over the main street before alighting. An evocative finale.

Undoubted stars are the Sunderlands and their crews, with splendid scenes of them at work, both on the water and in the air. The wardroom where some of the action takes place has an effigy of Hitler hanging up, as captured on a photo still of Lewis and Hewerdine.

Sqn Ldr Eddy Edwards, who had flown extensively with No 209 Squadron, was tasked with piloting the Catalina with the Film Unit cameramen aboard. He remembered in 1991, "My logbook shows 50 hours spent on this activity and I very clearly recollect one episode — that is the shot of me diving to the water and making evasive turns to simulate action to avoid enemy attack.

"Jonah Jones, in charge of the filming, discussed the method with me and I suggested his cameraman set up his camera behind the bomb-aimer's window. When all was set at about 1,000ft I asked the photographer if he was okay to roll, and down I went. After completing the manoeuvre, I asked if all was OK… no reply. And then he appeared with his head poking through the forward bulkhead door with the most terrified face I had ever seen. Looking at the film now I can understand what it must have looked like as the ocean came up at him at a great rate of knots, seemingly to his death! He didn't try again, so Jonah Jones took over."

Edwards recounted a moment of danger when one of the Sunderlands, being flown by Gp Capt Geoffrey Francis, force-landed off Frazerburgh Head on 30 May 1942. "I landed nearby to wait his instructions. Eventually he was towed to Invergordon… quite an experience. It could have been a disaster."

This incident happened during filming of the climactic 'air battle' when the Sunderland — identity not known — had an engine failure and made an emergency landing, happily on a calm ocean. Attempts to restart the engine failed and the machine began taxiing towards shore on three engines, later being towed by a pinnace for six hours back to base.

BELOW: Catalina I AH538 had been one of the first to serve with No 202 Squadron in Gibraltar. SQN LDR EDDY EDWARDS COLLECTION

LEFT: No 4 OTU had Sunderland P9606 on strength at this point.
SQN LDR EDDY EDWARDS COLLECTION

After all the sequences were in the can it was back to squadron duties for the crew of 'T for Tommy'. Many returned to No 228 Squadron, by then based at Castle Archdale in Northern Ireland. However, tragedy was already overtaking them. The charismatic captain, Johnny Hyde, chose to resume operations on the Beaufighter with No 248 Squadron at Dyce. On 29 April 1942, he was flying with his new comrades off Norway when he was shot down and killed along with his crewman. Hyde, who was 28, is buried at Trondheim (Stavne) Cemetery.

Lewis, Jones and Hewerdine joined the No 228 Squadron crew skippered by a very experienced Australian, Flt Lt Frank Goyen. In August 1942, at 228's new base at Oban, Goyen's crew was picked for a VIP flight conveying HRH the Duke of Kent, brother of King George VI, to Iceland with three members of his staff. The duke, an air commodore and inspector general of RAF welfare, was to visit air force stations there.

A Sunderland III, W4026, was specially prepared and painted for the mission and relocated to Invergordon on the Cromarty Firth. From there, in the early afternoon of 25 August, Goyen lifted W4026 off the water, heading north for Iceland. Just 32 minutes later it crashed 700ft above sea level in a remote part of Caithness. Rear turret gunner Flt Sgt Andy Jack had a miraculous escape, although badly burned. There were no other survivors. The three crewmen from *Coastal Command* were buried in their home areas: Charles Lewis at Letterston, Royston Jones at Aberavon and Teddy Hewerdine in Grantham, Lincolnshire. At the crash location — known as Eagle's Rock — a stone cross set on a plinth remembers the crew of W4026 and its royal passenger. The Duke of Kent was the first member of the Royal Family to die on active service in some 500 years.

> ***"I asked the photographer if he was OK to roll, and down I went"***

There were many favourable comments on *Coastal Command* in the press. "One of the finest films of the war", proclaimed the *Sunday Pictorial*. "A picture with abundant appeal", the *News of the World* stated. *The Times* thundered, "The Crown Film Unit has done for *Coastal Command* what in *Target for Tonight* it did for Bomber Command, and those responsible for interpreting the British war effort to America and Russia have now another strong card in their hands". On a similar theme the *Star* enthused, "The best and most exciting documentary film yet made about the feats of our flying forces, better even than *Target for Tonight*."

Coastal Command is forgotten by many, yet it is a powerful reflection of the unique challenges faced by the men involved in the unrelenting maritime war, and in particular those who flew the magnificent Sunderland.

EXACTLY IN TUNE

The stirring musical suite for *Coastal Command*, penned by Ralph Vaughan Williams, was played by the RAF Orchestra and conducted by Muir Mathieson, a former pupil of the renowned composer. It consists of eight movements, lasting a total of 23 minutes.

In a review for the Vaughan Williams Society Journal 25 years ago, Richard A. Young wrote, "*Coastal Command* was made to illustrate and promote to the public the unsung heroes of the command, a somewhat Cinderella outfit compared to the better known Fighter and Bomber Commands.

"The music produced was of such high quality that the film was cut to fit the music, not vice versa the normal procedure. Ken Cameron the Engineer on the film was speaking for the whole Crown Unit team when he wrote: 'We knew that here was something great, something indeed finer and more alive than any music we had ever had before. On the rare occasions when the music was slightly too long or too short to match the existing picture, then it was the visual material which suffered the mutilation.'

"The music for *Coastal Command* is as Vaughan Williams composed it. It is in fact the picture'."

MR FORTESCUE'S MAGNIFICENT MACHINES

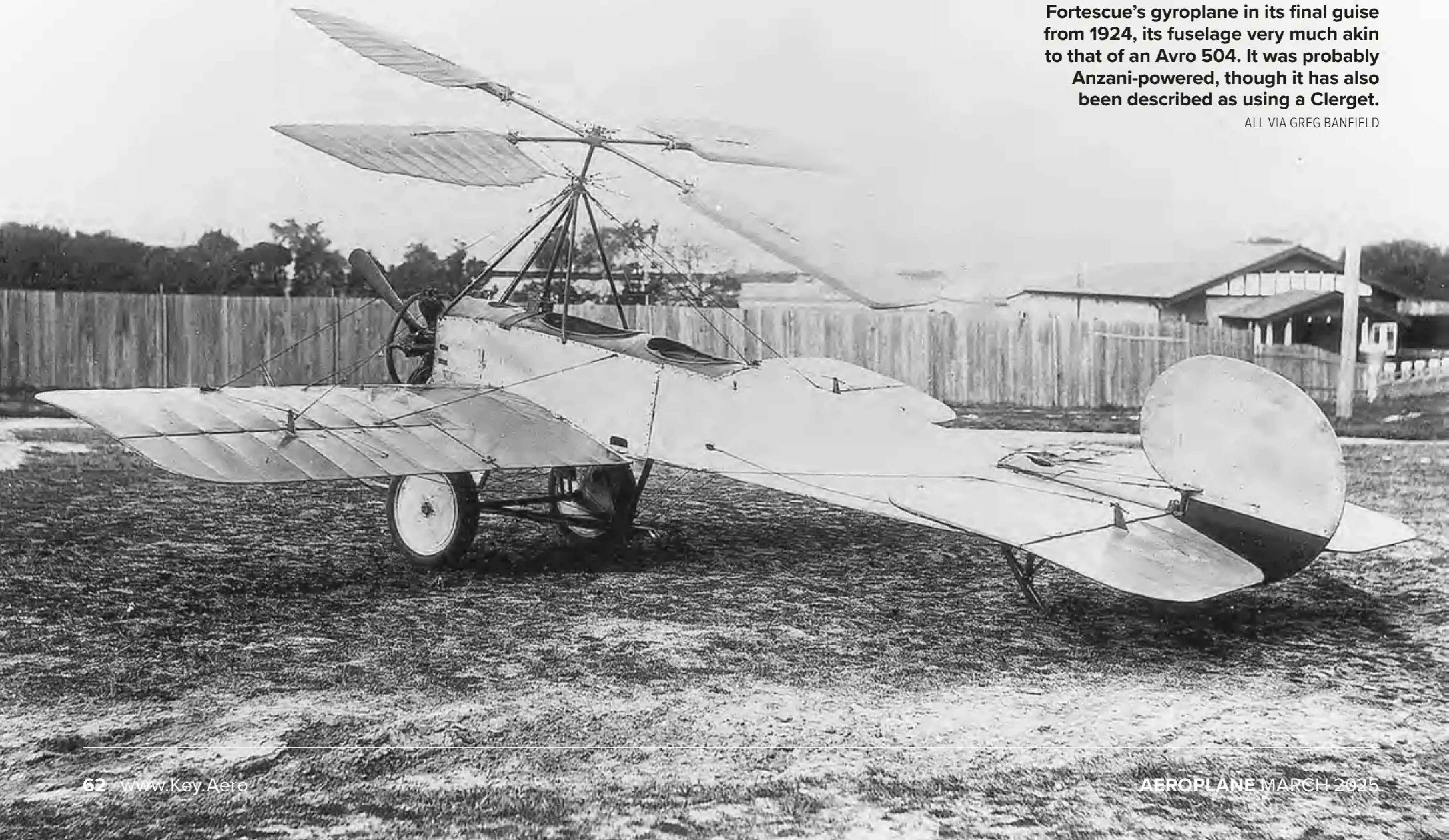
Does Australian engineer Albert Fortescue deserve to be acknowledged as the man behind the autogyro? Certainly, his efforts in a Sydney suburb were pioneering **WORDS:** GREG BANFIELD

It was of course Juan de la Cierva who invented the autogyro. Or did he? When first I heard of an Australian autogyro, built in Sydney by a Mr Fortescue, nobody could tell me anything specific about it. Late in 1981, I was fortunate to make contact with George W. Fortescue, whose uncle, Albert John Fortescue, had been the designer and builder of this elusive machine.

George Fortescue still lived in the family home in Loftus Street, in the Sydney suburb of Arncliffe, next door to the factory where his uncle first built his flying machines 70 years earlier. In fact, the building continued to have a link with aviation, as it was taken over by the Sydney Museum of Applied Arts and Science, and the museum's Blériot XI monoplane was prepared there for later display at the Powerhouse Museum.

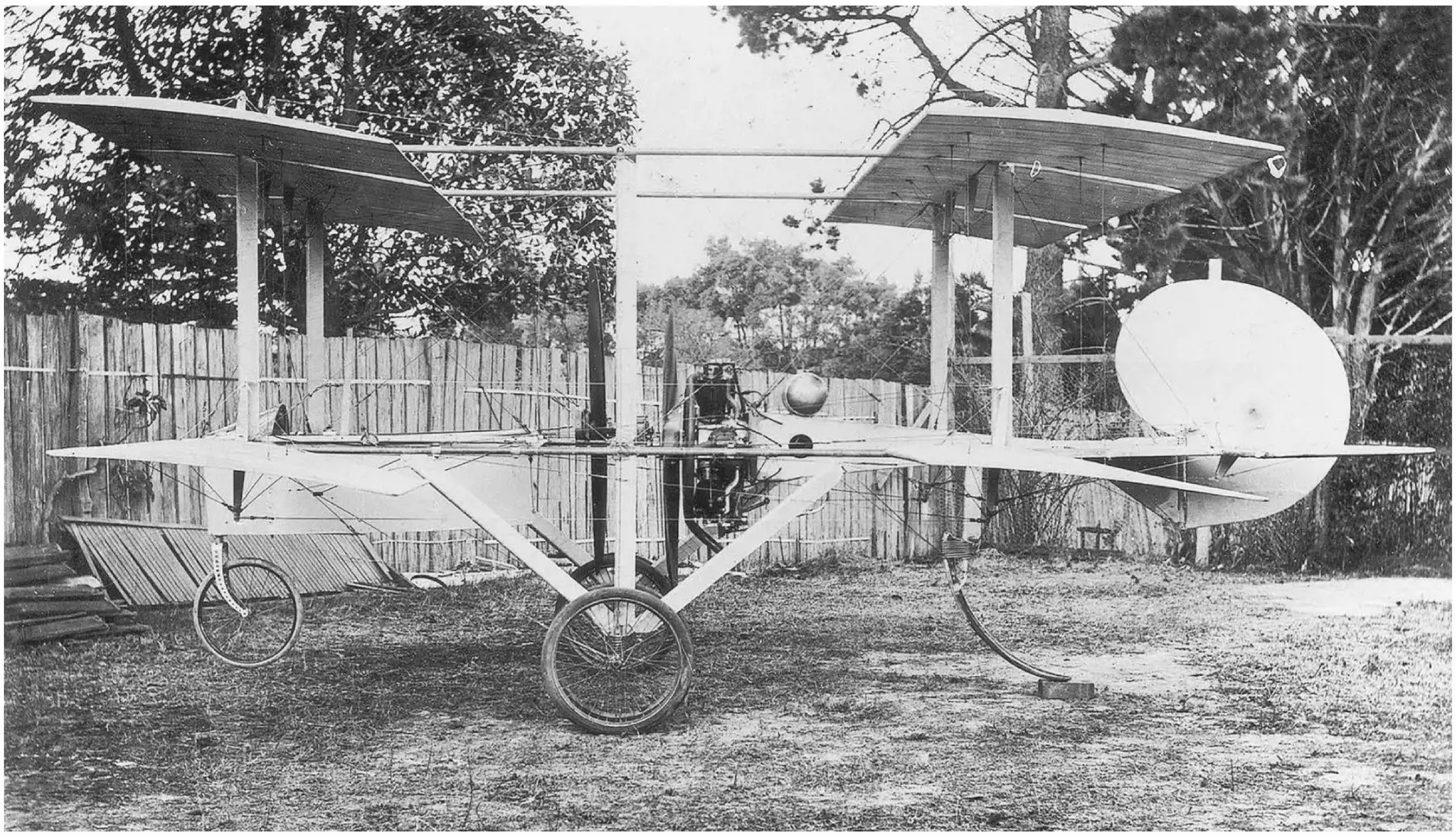
"The firm of G. E. Fortescue & Sons was established by my grandfather, George Edward Fortescue, in Yackandah, Victoria, in the last century," George Fortescue told me. "They manufactured agricultural implements such as firefighters, poison carts, fumigators, windmills and sulkies. The shop was transferred to Tallangatta, Victoria, and then in 1904 my grandfather and his four sons moved to Sydney and bought an area of land at Arncliffe, where they built a new factory. They brought 90 of their former staff from Victoria and resumed the manufacture of farm implements. In 1908 my grandfather sold the factory, but one of his sons, Albert — my uncle — stayed on as managing director for the new owners.

"Albert Fortescue became interested in aviation after the Wright brothers' first flight but he considered that their take-off run needed to be shorter, and he sought a way of reducing the length of runway. He started to experiment and first built a test vehicle to check the design of



Fortescue's gyroplane in its final guise from 1924, its fuselage very much akin to that of an Avro 504. It was probably Anzani-powered, though it has also been described as using a Clerget.

ALL VIA GREG BANFIELD



LEFT:
The test vehicle used by Fortescue to develop wing configurations in about 1907.

wings. This was powered by a motor car engine and he taxied it around on the Bonnie Doon golf course at Arncliffe, on what [became] the site of the Sydney Hilton International Airport Hotel, across the river from Kingsford Smith Airport.

"His next step was to build a monoplane, in about 1907 or 1908. The aircraft was entirely built here at the factory next door, in Loftus Street, Arncliffe. In 1909 he started to convert the monoplane to an autogyro. The wingspan was reduced, the structure altered and, no doubt, strengthened to take the rotor, and the fuselage was made so that it could be lengthened or shortened.

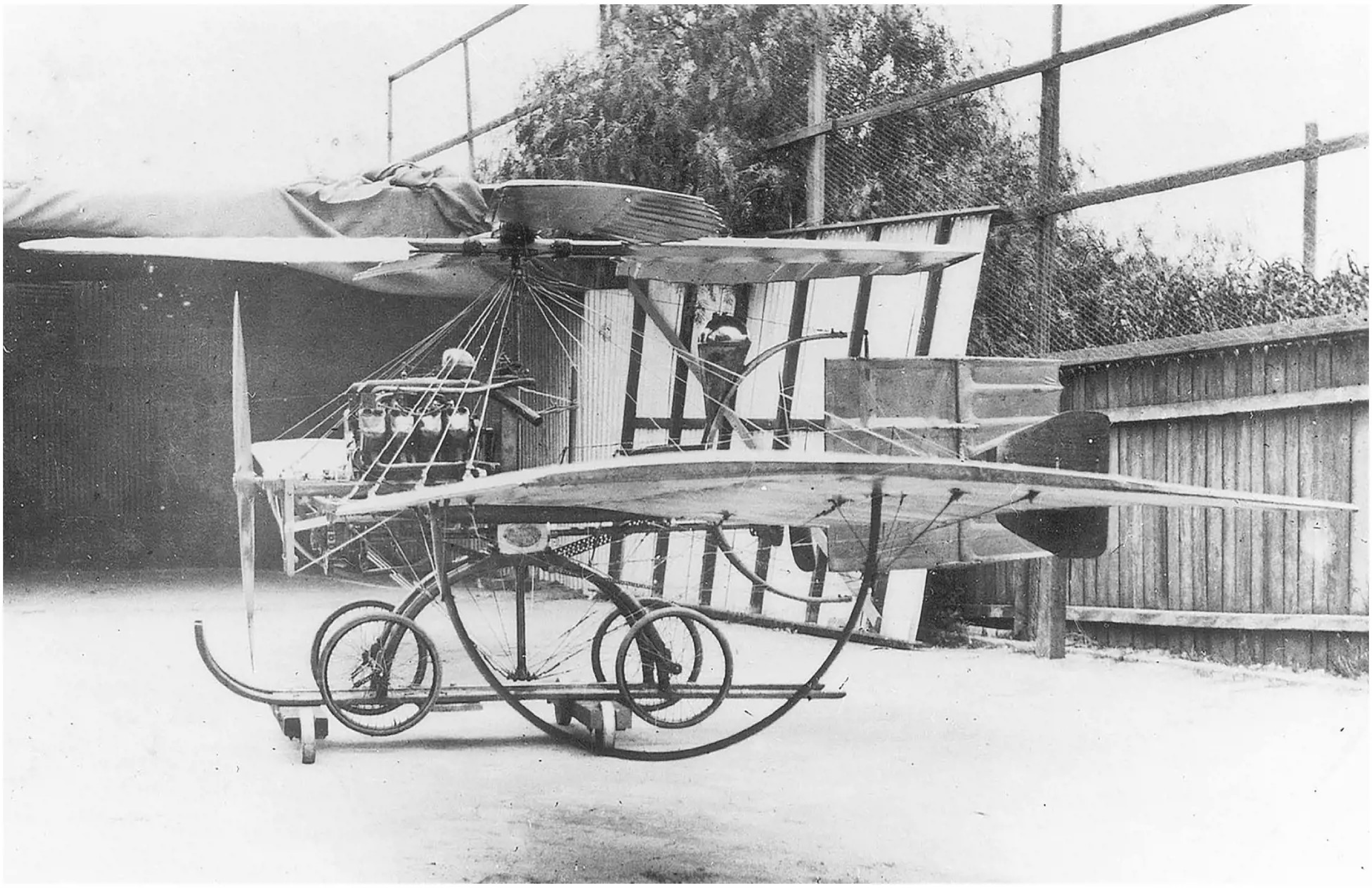
"We would take the autogyro down to the Bonnie Doon golf course for our trials as it was the closest big stretch of reasonably clear and level surface we could find. We used to fly it pretty well every time we took it down there, generally early on Sunday mornings so we could transport it down the road when there was no traffic about. For a period of about three years, from 1909 to 1912, we carried out trials with it. We had no scientific testing equipment such as wind tunnels, and it was very much a matter of trial and error. We would test it and my uncle would assess the results, bring it home and make adjustments to this or that."

In 1909 Albert Fortescue was granted first patent protection for his autogyro, while the provisional patent followed during 1912, and a full patent in four countries became effective in 1914. He was assisted in the building of his machine by his youngest daughter, Dora.

> *"We would take the autogyro down to Bonnie Doon golf course for trials"*

George Fortescue said that when an early Sydney aviation company closed down, a sale was held of a great variety of equipment and spare parts. It is probable this firm was the Australian Aircraft and Engineering Company, which manufactured Avro 504s under licence and which closed in 1923. He continued, "My uncle, not knowing which parts he would

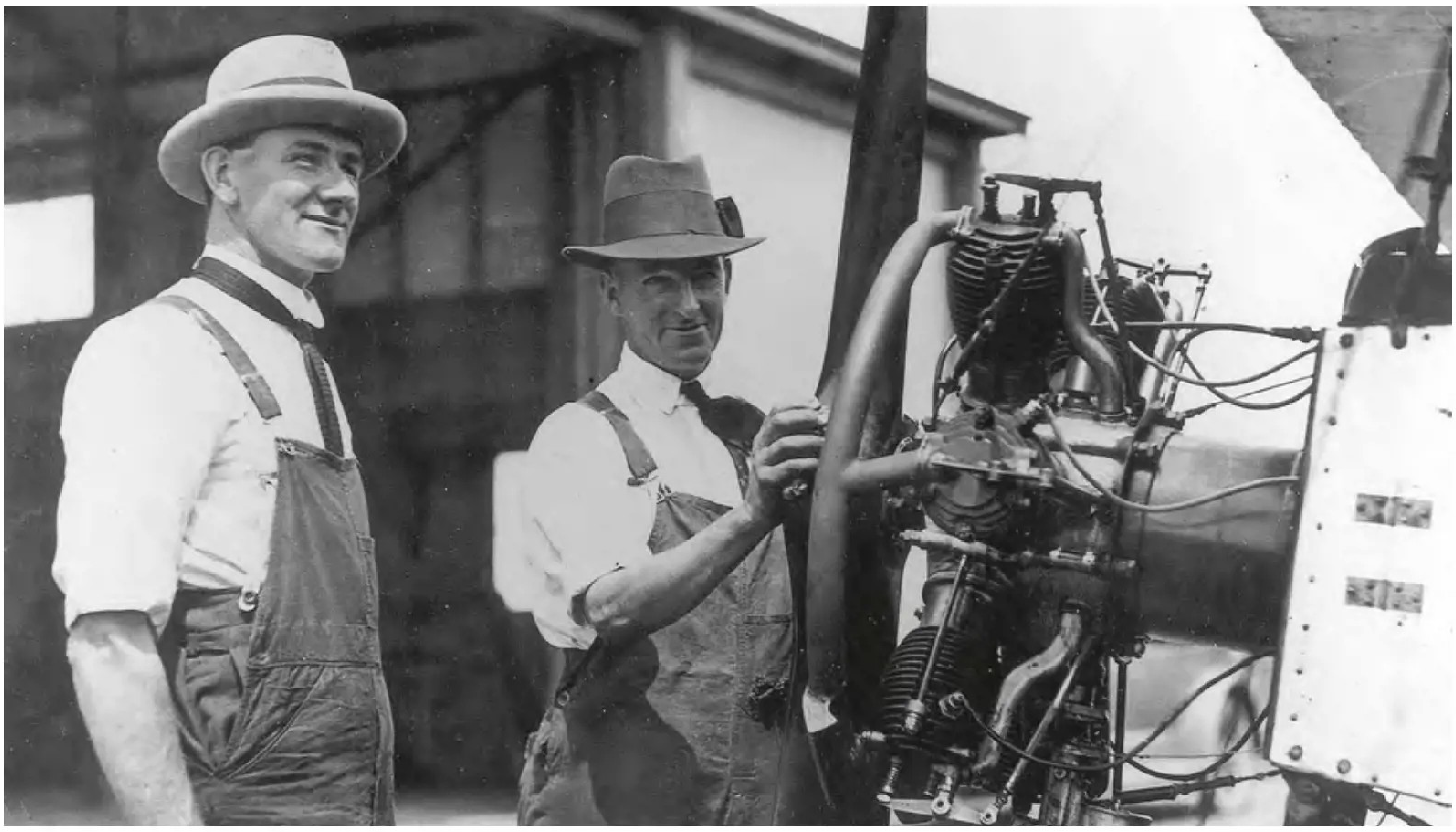
LEFT:
George Fortescue in verdant surroundings.



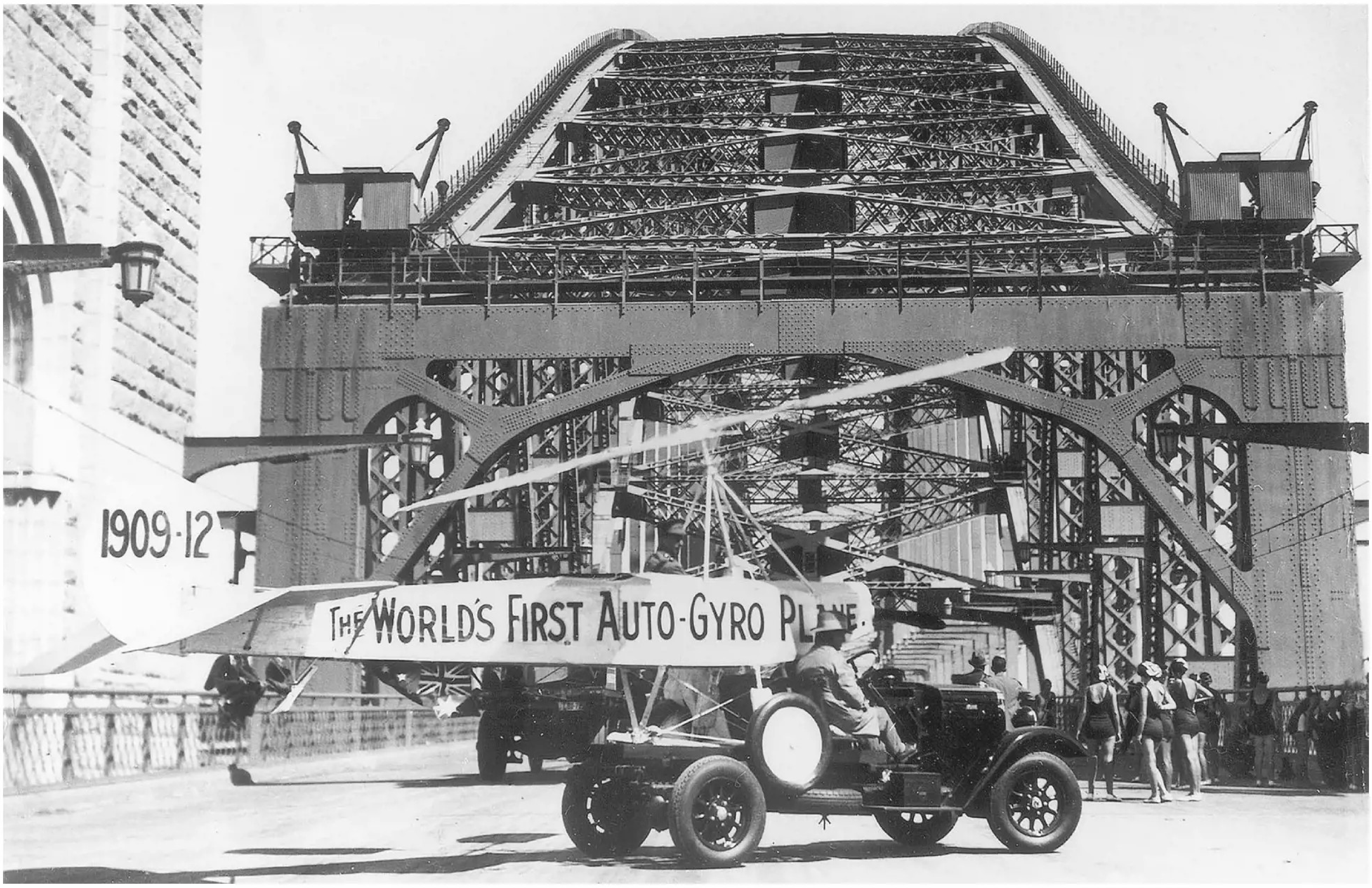
ABOVE: Conversion of Fortescue's earliest monoplane into an autogyro got under way in 1909, in which year it was first patented.

need, bought the lot and kept them stored in the factory for years. As a result, I came to know people such as Arthur Butler, Goya Henry, Hudson Fysh, [Lawrence[Wackett and Nigel Love, who would call on my uncle seeking to buy some of the bits and pieces he had bought.

"Albert Fortescue had a number of engines and later fitted a Clerget engine to the autogyro, which was the final installation. The machine took off in about one-third of the distance that the Wrights required. His pilot was a Mr Nelson, but he wouldn't take it up more than about 6-8ft in height because he found that the controls weren't answering properly. He said that the machine would rise higher but he could feel that there was some instability in the controls and he wasn't prepared to risk his life taking it higher. It attained speeds of about 40-50mph, about the speed of a fast motor car in



RIGHT: Bob Burton (left) and Con Waters with the autogyro which they helped to build.



ABOVE:
A proud boast for the Fortescue autogyro, as it's exhibited as part of celebrations to mark the opening of Sydney Harbour Bridge on 19 March 1932.

those days, although speed was not the main aim."

In the George A. Taylor Memorial Lecture on Aeronautics delivered at Sydney University on 8 April 1931, Prof T. D. J. Leech, lecturer in aerodynamics, noted that the Fortescue autogyro closely anticipated that of Cierva. The essential difference between Fortescue's patent and that of Cierva was extremely small, and amounted to a variation in the method of attaching the rotating vanes to the mast. Fortescue contested Cierva's right to the autogyro, but it was found that Cierva had applied for his patents 14 days after those of Fortescue had lapsed.

Prof Leech said the gyroplane was built in 1924 and was fitted with an Anzani engine at Sydney's Walsh Island Dockyard. George Fortescue remembered the engine as a Clerget, but both are of similar appearance. However, a photograph of the machine shows it to have a fuselage very like that of an Avro 504, which may have been among the items purchased from the Australian Aircraft and Engineering Company sale.

Also in 1924, Fortescue built a monoplane for the Light Aircraft Competition which was held at Richmond, New South Wales, from 29 November-6 December 1924. It was flown at Mascot by Reg Nelson but was damaged during the tests and failed to arrive at Richmond to compete. Reg Nelson was a World War One pilot, who received a permanent Royal Australian Air Force commission in World War Two. He later retired to Queensland, where he died in 1980.

> ***"The difference between Fortescue's patent and Cierva's was very small"***

"The factory staff helped my uncle with the construction and all the modifications," said George Fortescue. "One of those assisting was Bob Burton, who was one of the men who moved up from Victoria in 1904. He served in the First World War and later dropped dead while marching with his cobbers through the streets of Sydney one Anzac Day.

"The development work continued until Cierva perfected his autogyro. My uncle's work then became redundant, as the problem of short take-off had been solved, first by Cierva and later by Sikorsky, and he closed the project down. He had spent half his life pursuing the idea.

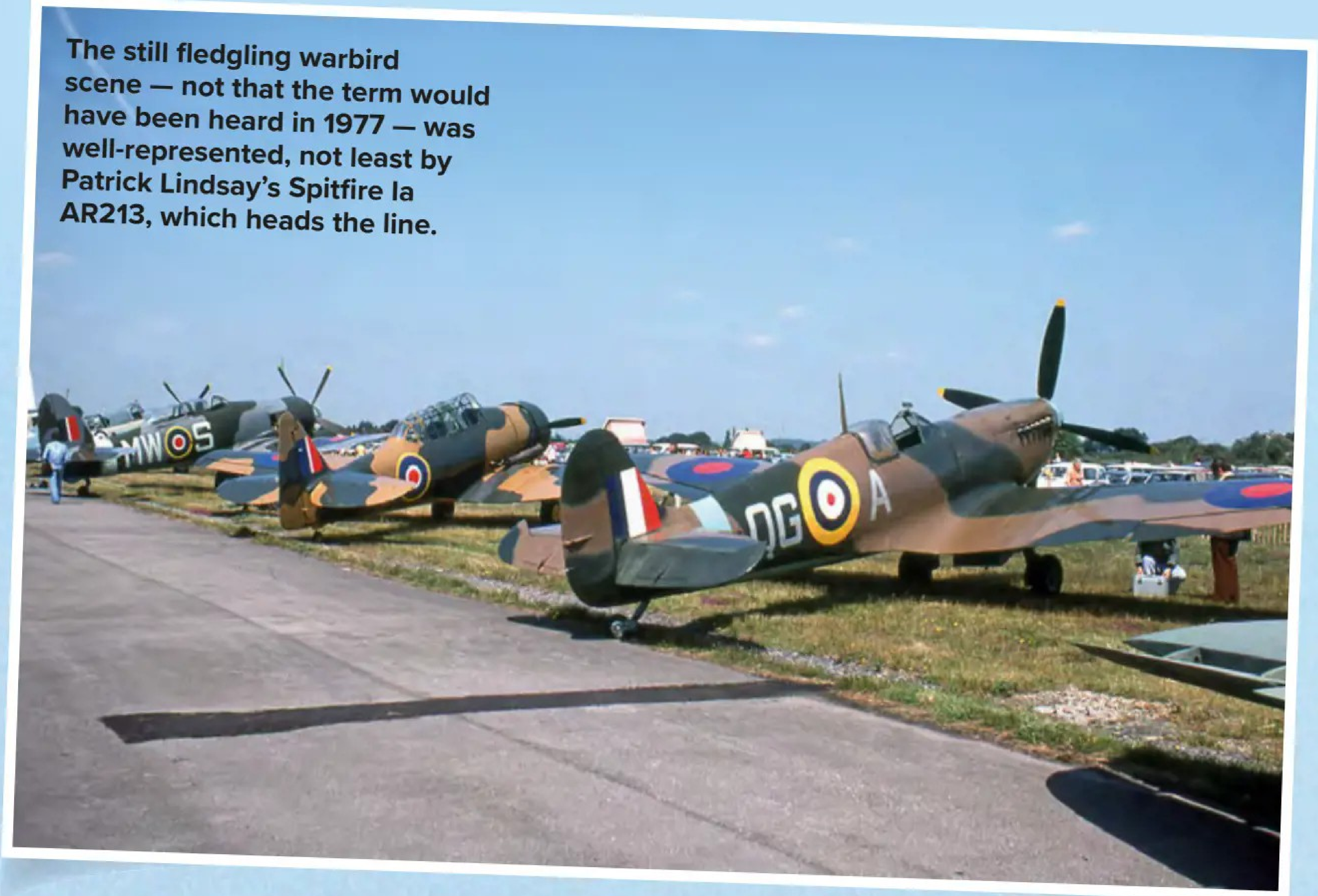
"When Albert Fortescue died in 1936 at the age of 66, two cousins of mine bought the autogyro from the estate. Leslie Hawley and Victor Fortescue, who had a garage near Wollongong, NSW, where it was kept, shared the machine equally. They had plenty of land there to be able to try it out and run it. Then Victor died, and in 1975 Les Hawley also died. The machine could still have been around until then. I have heard a report that a hiker came across an old mine-pit near Wollongong and saw an old aeroplane dumped half-way down it. It could possibly have been my uncle's autogyro, which may have been dumped when my cousin died."

The story of Albert Fortescue is another example of an imaginative and pioneering Australian inventor whose work was not appreciated in his own country. It is our loss that we do not have a more detailed record of his efforts.

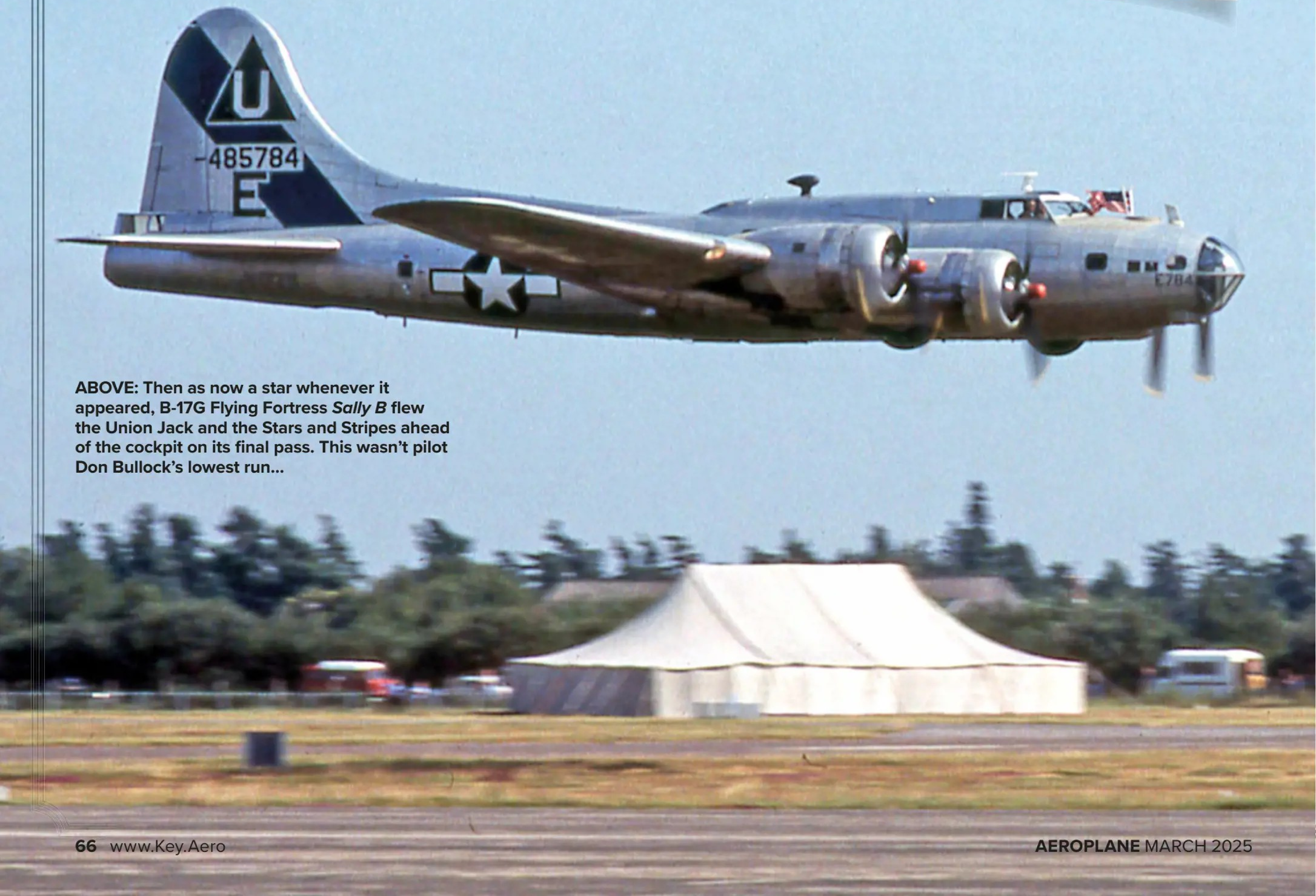
BLACKBUSHE

1977

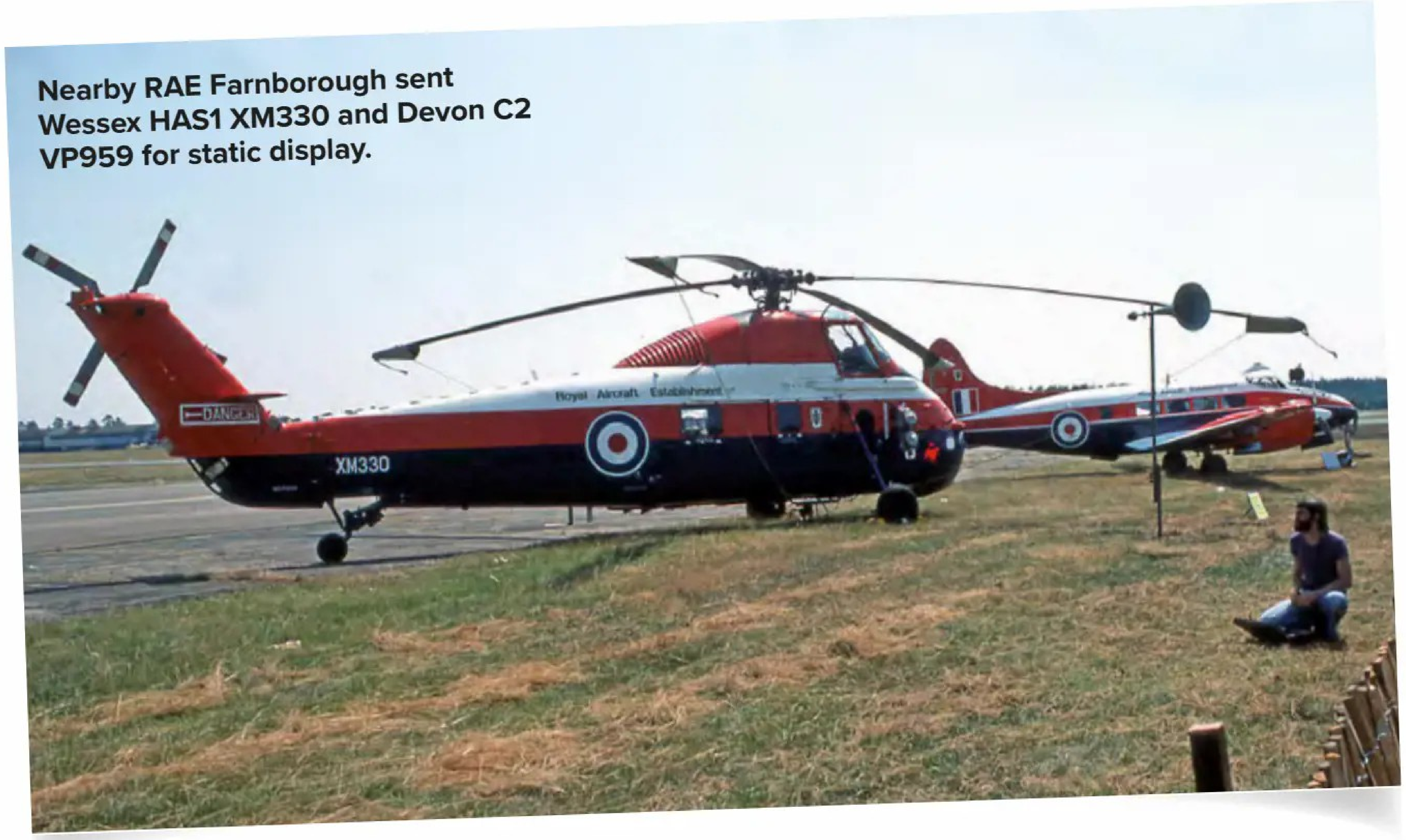
During one of his flying visits to the UK with friends, Norwegian enthusiast **Bjoern Boe** took in the Blackbushe Air Festival on 30 July 1977 — a notably memorable show of the period



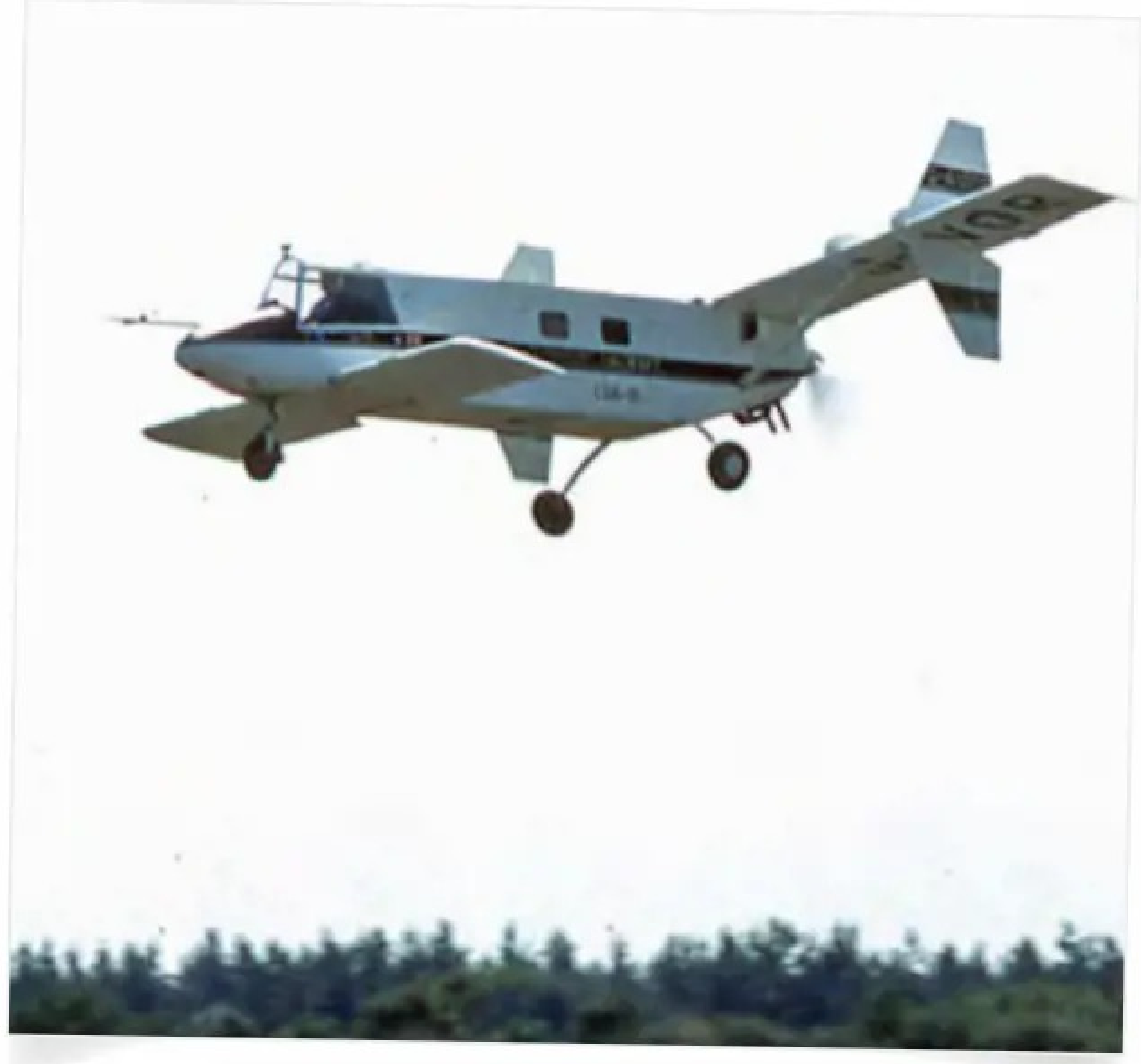
The still fledgling warbird scene — not that the term would have been heard in 1977 — was well-represented, not least by Patrick Lindsay's Spitfire Ia AR213, which heads the line.



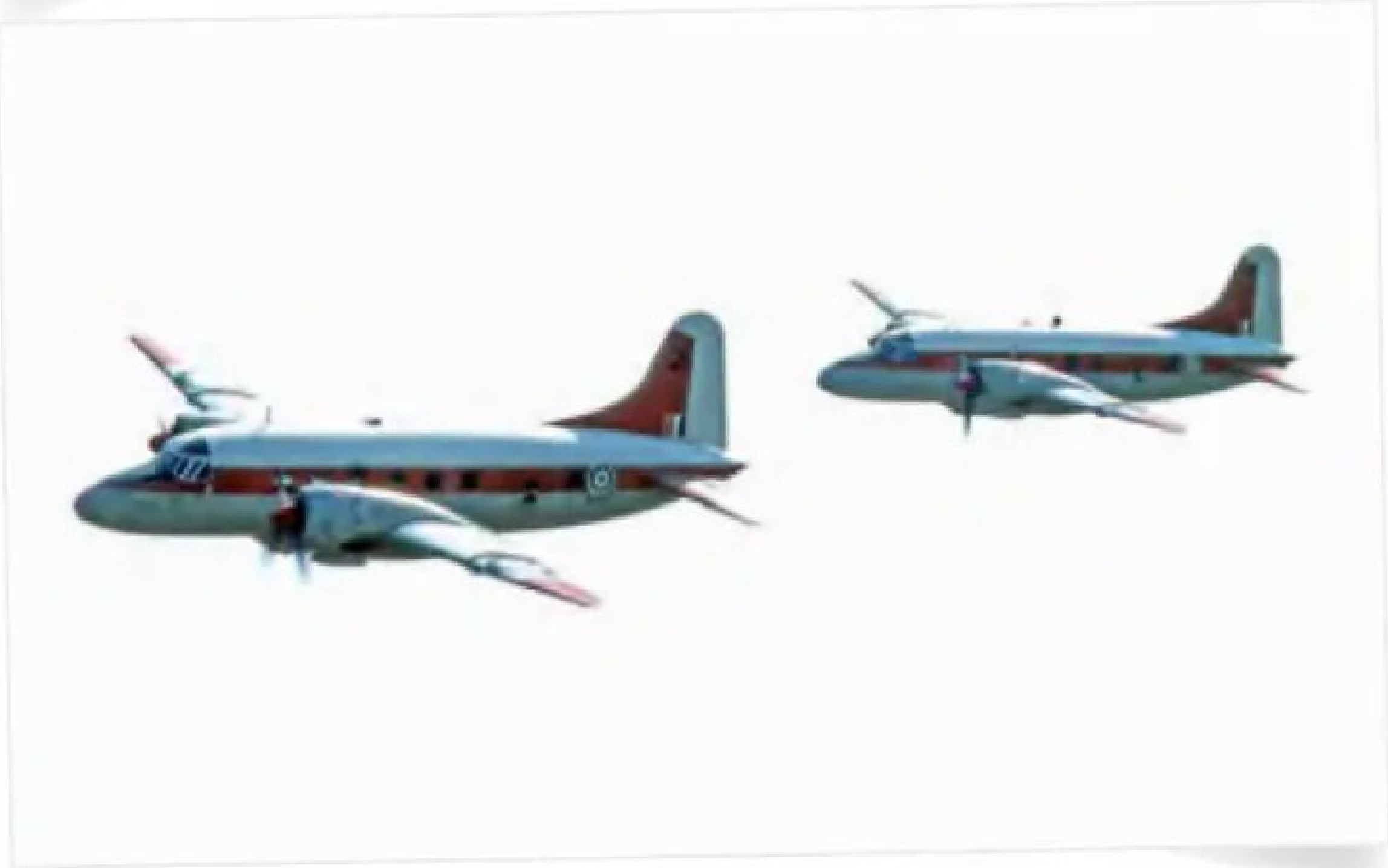
ABOVE: Then as now a star whenever it appeared, B-17G Flying Fortress *Sally B* flew the Union Jack and the Stars and Stripes ahead of the cockpit on its final pass. This wasn't pilot Don Bullock's lowest run…

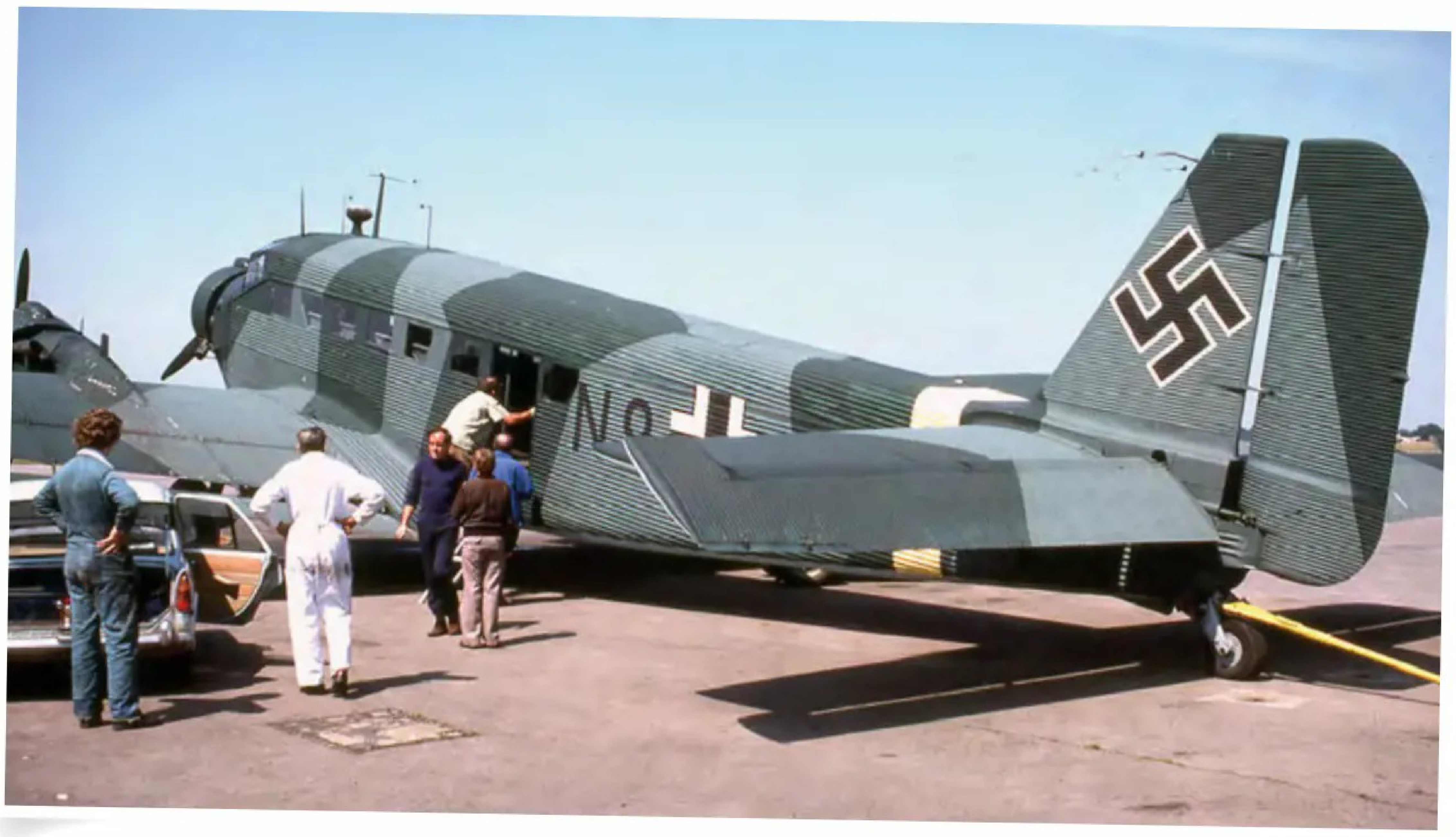


Nearby RAE Farnborough sent Wessex HAS1 XM330 and Devon C2 VP959 for static display.



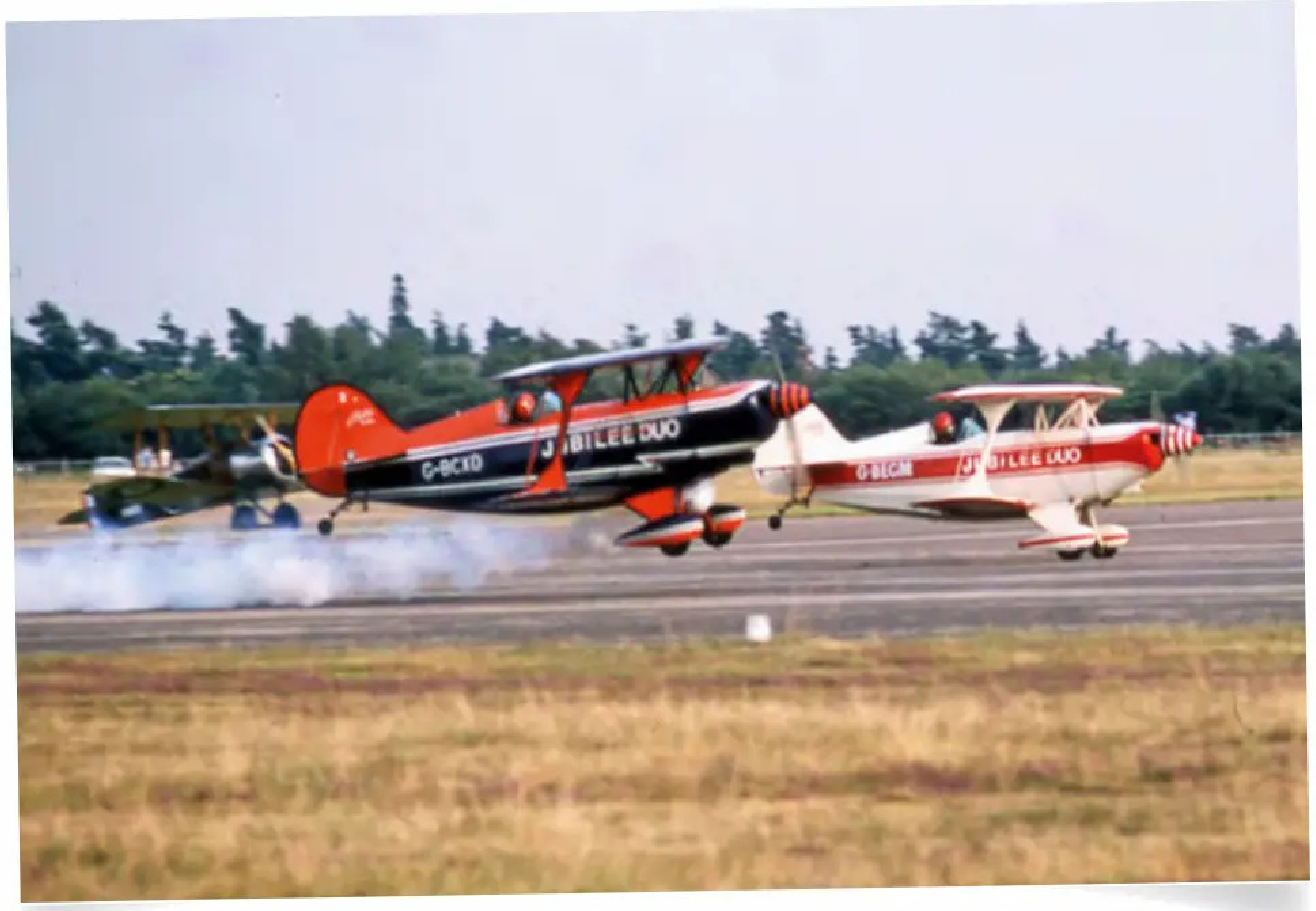
Civilian rarities loomed large in the flying programme. There were flypasts from such as a British Air Ferries Carvair, British Airways Boeing 747-136 and IAS DC-8 — but none of those 'heavies' had the one-off novelty value of the Lockspeiser LDA-01, G-AVOR, piloted by its creator David Lockspeiser.



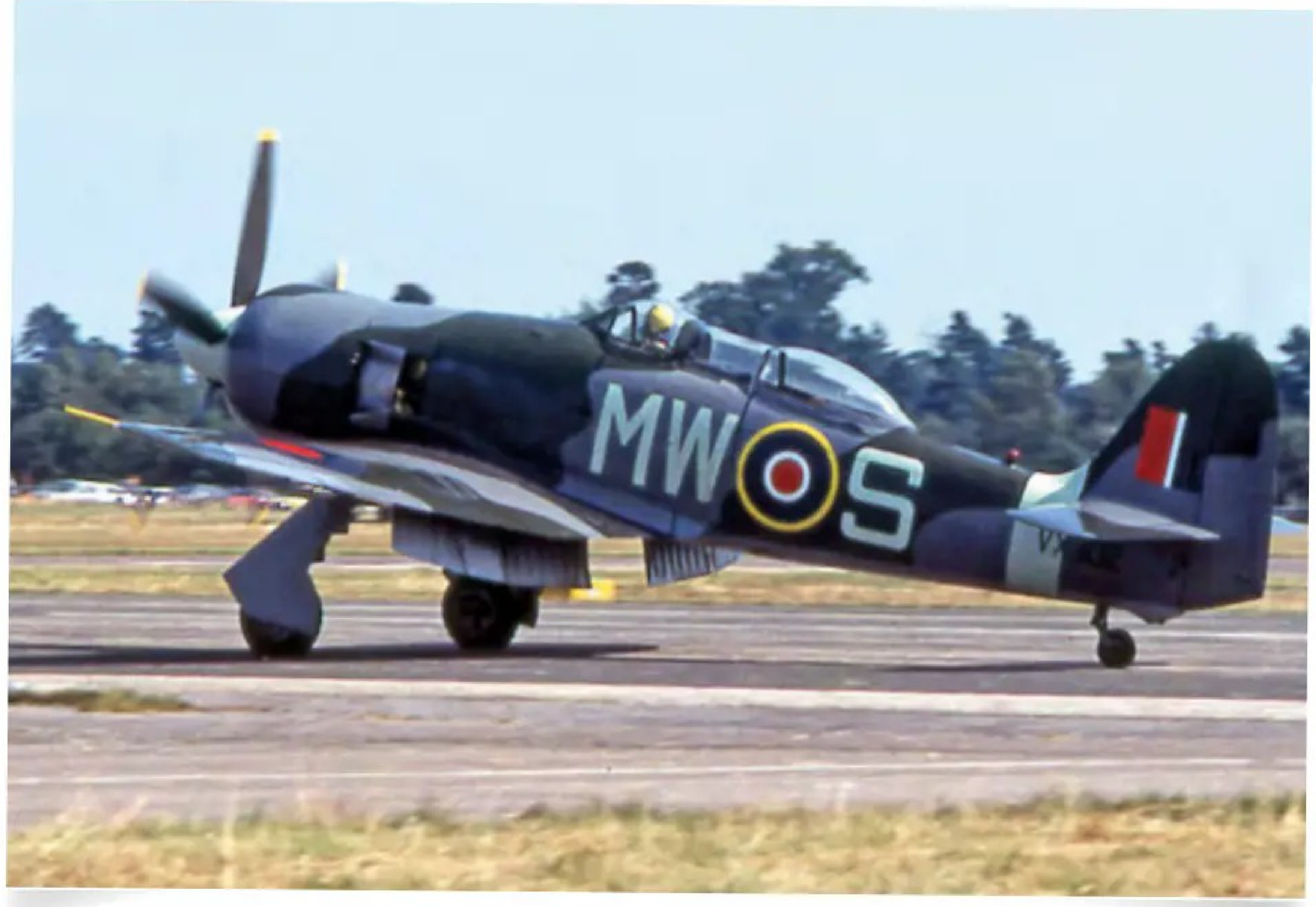


ABOVE: Now here was a unique sight: the one time the only two privately owned, airworthy Varsity T1s flew together. WJ945/G-BEDV of the Duxford Aviation Society led the ill-fated WJ897/G-BDFT from the Leicester Aircraft Preservation Group.

RIGHT: One of Doug Arnold's Blackbushe-based aeroplanes to feature in the show was CASA 352L — Spanish-built Junkers Ju 52/3m — G-BECL, which conducted a solo display and a parachute drop. Among those standing near the tri-motor transport is pilot Peter Hoar, wearing the dark blue sweater.



Formed to appear in the Queen's silver jubilee year, the Pitts S-2A-mounted Jubilee Duo involved pilots Bob Thompson and Marcus Edwards. In the background, having landed on the grass strip, is Leisure Sport's Sopwith Camel replica.



Aside from the RN Historic Flight's FB11, a second Sea Fury on the bill was T20S VX302/G-BCOV, which — as the registration suggests — had been sold by Doug Arnold's Warbirds of Great Britain organisation to Mike Stow.

Have you got photos to contribute to Personal Album? If so, e-mail the editor at ben.dunnell@keypublishing.com

SIZING UP THE OPPOSITION

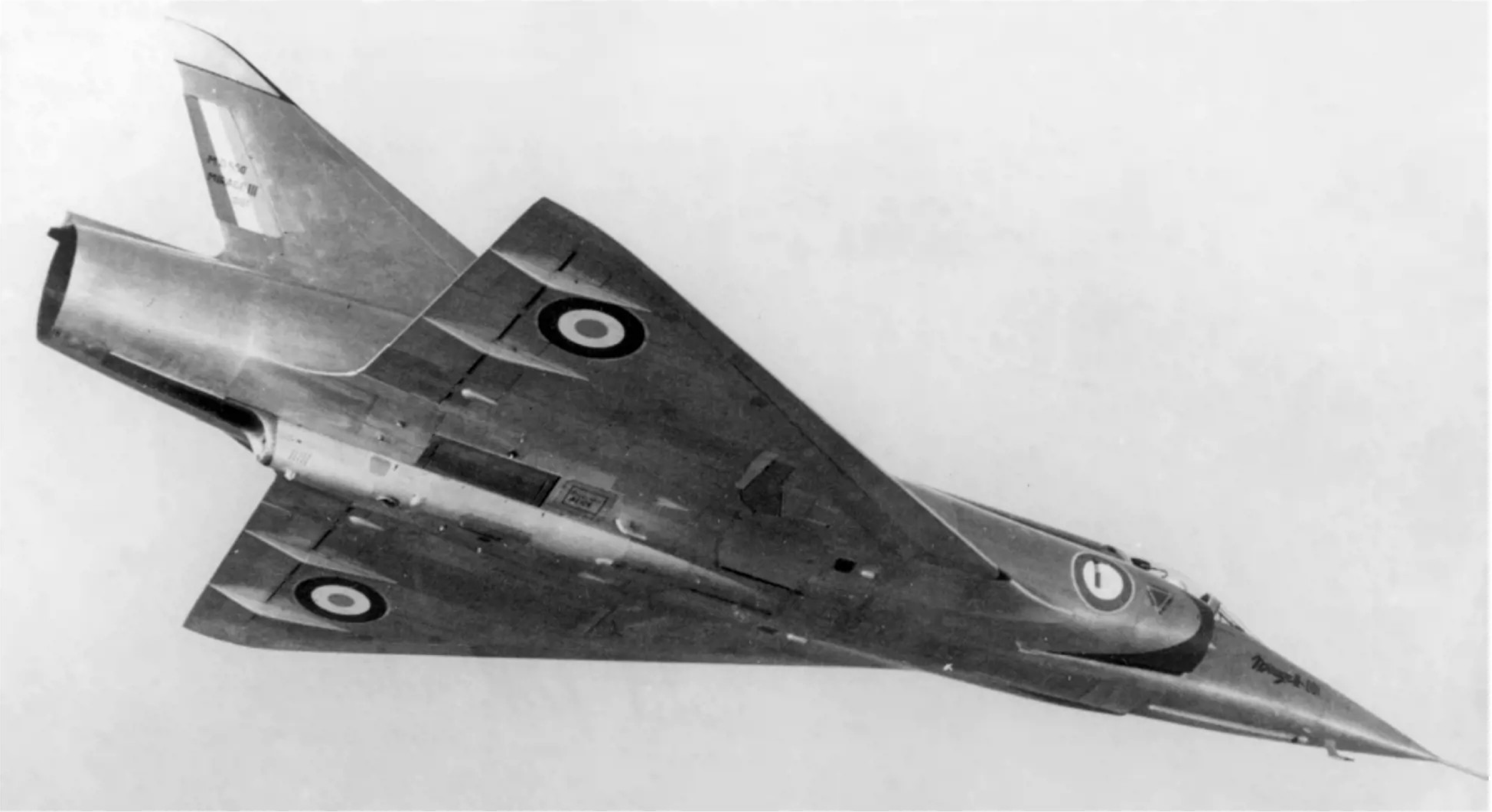
What did Boscombe Down's test pilots make of the Dassault Mirage III? A 1960 evaluation gives their verdict **WORDS:** BEN DUNNELL

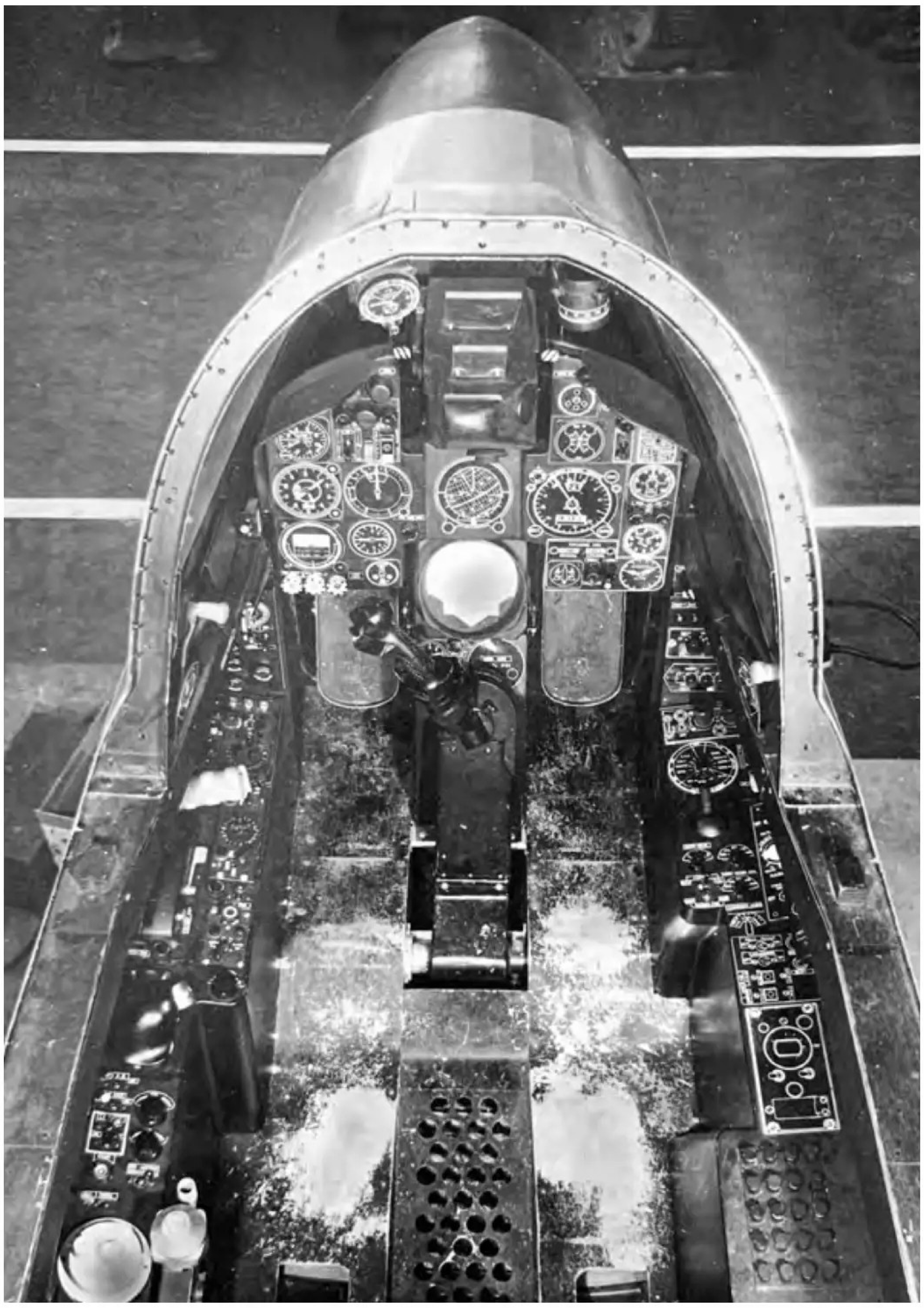
January 1960. Just four days into a new decade, and a new era for Fighter Command. At RAF Coltishall in Norfolk, biting winds blowing in from the North Sea, the establishment of the Lightning Conversion Unit heralded the in-service advent of Britain's first Mach 2 fighter. It was a capability no other western European air arm possessed. But when it came to flying at twice the speed of sound, English Electric's Cold War masterpiece hadn't led the way in attaining that achievement. And just as East Anglia was getting used to the sound of twin afterburning Rolls-Royce Avons, so a pair of test pilots from the Aeroplane and Armament Experimental Establishment were readying themselves to sample the aircraft that had.

It was Dassault's Roland Glavany — a wartime parachute commando, no less — who, on 24 October 1958, took the controls of Mirage IIIA prototype 01 and proved the double-delta fighter was Europe's first Mach 2 combat aircraft. The event happened just over five months on from the Mirage's maiden flight. Not for another few weeks, on 25 November, would Roland Beamont conduct the English Electric P1B to the same milestone. It had been more than four years since the initial P1A took to the air. But if vacillations of policy meant the RAF took a long time to receive the production Lightning, it still beat the Mirage to the front line. When the offer came from the French authorities to evaluate their aeroplane, a potential competitor for export sales, it was not about to be passed up.

So it was that the A&AEE's Sqn Ldr Alan Merriman and Flt Lt Lou Cockerill, joined by flight

Carrying long-range 1,300-litre fuel tanks and an SAMP 400kg freefall bomb, Mirage IIIA serial 01 rotates. Fitted with parachute retardation, this type of bomb later equipped the Mirage IIIE in service. ALAMY





test engineers Richard Guntrip and J. D. Bennett, travelled out to Istres in January 1960. At the southern French home of the Centre d'Essais en Vol (CEV), the national flight test centre, they were afforded the opportunity to fly Mirage IIIAs 01 and 08, while a trip to the Avions Marcel Dassault factory at Argenteuil in north-western Paris brought insights into the type's design and manufacturing. It was not a full, lengthy assessment — "The object of the tests was to obtain as wide an impression of the aircraft's characteristics and potential as was possible during the brief visit" — but it gave Britain a chance to find out much more about another interpretation of the state of the fighter art.

"The design philosophy", the subsequent A&AEE report stated, "was to produce a relatively small simple aircraft capable of Mach 2 high altitude interceptions, low altitude nuclear attack and conventional close support ground attack sorties. Also it was required that it should be capable of operating from short, semi-prepared airstrips and that changes of role should be accomplished with the minimum of delay on the ground. These design aims were borne in mind throughout the evaluation."

So were the differences between the two aeroplanes put at the Britons' disposal, and

ABOVE: A SEPR 841 rocket pack equips aircraft 01. When the A&AEE pilots flew the Mirage, it was 08 on which they sampled the rocket power. ALAMY

LEFT: A virtually production-standard Mirage III cockpit as of 1960. Of the two examples piloted by the Boscombe testers, 08 was so configured. DASSAULT

Mirage III-A 05
SNECMA
ATAR 9
05

ABOVE: **Among the pre-production Mirage IIIAs flying by 1960 was serial 05, which was fitted with the nose-mounted Cyrano I fire control radar.** ALAMY

between these machines and the series production examples yet to roll off the line. While first prototype 01 had a small, pointed metal nose with a long nose probe for test purposes — this allied to comprehensive performance and handling instrumentation — pre-production airframe 08 was fitted with the production-standard radar nose and a short probe, together with only basic instrumentation. The first aircraft's cockpit layout was non-standard, the eighth's "almost to production standard". In the rear fuselage pack of 01 was installed a fuel tank, while 08 carried the SEPR 841 liquid-fuelled rocket motor developed by the Société d'Études pour la Propulsion par Réaction. There were also important variations between their flight controls. The stick/elevator gearing on 01 could be selected by the pilot, while its auto-stabilisers had automatic gain control; 08's stick/elevator gearing were fixed and the gain control for the auto-stabilisers was manual. Neither had a production fire-control system.

While detailed observations were made on the ground, the meat of the report deals with the Mirage III's flying characteristics. Merriman, who later went on in a very distinguished career to command the A&AEE but was then on its 'A' Squadron, wrote, "All take-offs were made without use of reheat and with dampers on. After obtaining full throttle on the brakes and waiting for the jet pipe temperature to reach 700° with the nozzle slowly closing, the brakes were released and the aircraft kept straight initially by use of brake. The acceleration was moderate" — both pilots said it was similar in that respect to a Hunter F6 — "and the rudder became effective at about 60-70 knots. With the stick held hard back the nose wheel lifted at 110 knots and the stick was then moved forward slightly to hold the correct nose-up position. Overcorrecting occurred and it was found very difficult to stop the nose oscillating up and down around the mean position — this was found to be pilot induced. Because of this nose oscillation the aircraft was not flown off until 170 kts on the first take off, but with subsequent practice the pitching oscillation was considerably reduced and an airborne speed of 155 kts was achieved on one take

> ***"On selecting reheat, the acceleration was 'fairly rapid'"***

RIGHT: **Rough-field runway trials by Mirage IIIA 01.** KEY COLLECTION

The SEPR rockets are demonstrated spectacularly by a trio of production Mirage IIIEs. GETTY

The first two-seat Mirage IIIB had flown in October 1959, but was not part of the A&AEE assessment. ALAMY

off accompanied by light buffet for a short time. Once above 200 knots the overcontrolling in pitch disappeared and pitch control was good and precise. Lateral control was good throughout. The nose position on take-off was very high and forward view of the runway was cut off for a short while."

The climb, carried out at slightly slower speeds with the weight of the rocket pack and its fuel, was largely uneventful. One exception was if the speed crept above the recommended Mach 0.90 without the rockets to Mach 0.92. Then, "the beginning of the transonic nose down trim change could be felt and this very small change of trim made the aircraft more difficult to trim hands off."

❖

Levelling off at 5,000ft, full throttle — but no afterburner — was engaged on the single SNECMA Atar 9C engine and the Mirage accelerated from 300kt to 585kt, or Mach 0.96. As the speed rose to around the Mach 0.92-0.94 mark, again, "a slight nose down trim change was felt and changes in lateral trim became evident, the starboard wing dropping about 5° and later recovering. The aileron trimmer knob was turned a long way in order to effect a small change of trim and was considered too slow in operation to overcome these random changes of lateral trim. At 585 knots the aircraft was pleasant to handle but cockpit noise was unpleasantly high."

On selecting reheat at 550kt and 5,000ft, "There was a marked increase in thrust and the acceleration was fairly rapid. The transonic trim change was very slight and the jump up on the altimeter was approx 300 feet with the Mach meter jumping from .99 to 1.02 M. The acceleration from 550 kts to 680 kts took approx 1 minute. Control of the aircraft remained extremely good both dampers on and off."

Merriman found that, "700 kts could be maintained with just less than maximum reheat. At this speed control was good but a general airframe shaking was felt and the cockpit noise level was very high.

"At 20,000 feet accelerations from .9 M to 1.2 M using maximum reheat were carried out. The acceleration was fairly marked when reheat was engaged and the aircraft quickly became supersonic on increasing to max reheat. The transonic trim change was slight and occurred between .94-.98 M". When the Mirage reached Mach 0.99, there was a "jump up" on the altimeter of around 500ft and the speed "rose quickly" to Mach 1.02. From then on no change of trim was felt. "At 1.2 M (580 kts) the cockpit noise level was becoming high. The airbrakes were then extended and the engine throttled right back; this gave an impressive deceleration with no noticeable trim change, but the transonic trim change under these conditions was apparent in the form of a sudden pronounced nose down-nose up motion."

It took about two seconds for the afterburner to engage at 36,000ft and Mach 0.9, at which moment there were "fairly large fluctuations" on the gauges showing rpm and jet pipe temperature. However, they settled down after circa five seconds, following which, "the throttle was advanced to maximum reheat and a level acceleration carried out with the dampers on, low gear selected and the stick force 'g' unit on.

"The transonic trim change was felt from .93 to .97 M and whilst not being of very large proportions it was larger than contemporary supersonic aircraft. At .98 M the jump up occurred to 1.03 M with the altimeter jumping approx 1,300 feet at the same time. Nose up trim change was felt up to 1.1 M, then no change occurred up to 1.3 M, when a steady nose down trim change occurred up to Mach 2. All these changes of trim were of small proportions and approx 5 lbs stick forces would hold them". A "general high frequency light airframe buffeting" could be felt as the speed rose towards Mach 2.

On a flight in aircraft 08 with the rocket motor fitted, it was selected to full power at Mach 1.5 and accelerated the Mirage to Mach 2. The SEPR 841 was quoted as producing 3,300lb static thrust and burning for 80 seconds, though it could also be throttled at 1,650lb thrust to allow a longer burn. According to Merriman, "The rocket lit up with two distinct thrust pulses which gave no change in trim. When switched off it cut with a very loud bang". That happened after the aeroplane had climbed at a constant Mach 2 to 50,000ft, at which point the Atar's reheat was also disengaged, airbrakes extended and "a gentle push-over started". At the 59,000ft apex, Mach 1.85 was recorded. It's interesting to bear in mind that the RAF's early Lightning F1s were restricted to Mach 1.7 under their release to service from the Controller, Aircraft.

> ***"Merriman said the Mirage III was 'extremely impressive'"***

Manoeuvring tests began at subsonic speeds, specifically a 6g turn at 585kt. "The stick force was estimated at 20-25 lbs and handling in the turn was very pleasant", said Merriman. As speed decreased, "The aircraft was easy to control in the turn and there was no tendency for stick lightening or pitch up to occur". Supersonic turns were generally fine, but when conducting a "descending spiral" from 59,000ft and Mach 1.85 to 50,000ft and subsonic with the stick fully back, "The pitch up on becoming subsonic was most pronounced and the sharp push forward to counteract it started a pitching oscillation which was very difficult to get in phase with, and which was finally overcome by letting go of the control column."

Aerobatics were tried too. "At heights between 5 to 10,000 feet loops and rolls were executed with no problems being encountered. The general handling was considered very pleasant with good stick forces and harmonisation. Loops were entered at 450 and 430 knots with full throttle giving 200 knots over the top with a 4 'g' pull up. As the speed fell off going over the top the angle of attack gauge and lights were

Aircraft 05 comes in to land at Le Bourget after a display at the 1959 Paris Salon.
ALAMY

Mirage III A 08

Having been flown by the British test pilots, Mirage IIIA 08 carried on a lengthy career, here carrying a Matra R530 air-to-air missile under the fuselage. GETTY

most useful to prevent reaching too high an angle of attack with very low applied 'g' values."

More challenges were evident when the Mirage was being prepared to land. Breaking onto the downwind leg, extending the airbrakes, throttling back to idle, pulling some 4g and climbing from the 500ft break to 1,000ft, "the air speed fell off rapidly at first but once levelled off downwind it took an appreciable time to lose speed down to 230 kts for undercarriage lowering". The airbrakes were brought in once the undercarriage was locked down. It was found necessary to open up to around 7,500rpm "fairly quickly in order to avoid the speed dropping rapidly".

The turn onto final approach was made at 200kt with a 40° angle of bank. The angle of attack gauge showed 13, "and a light buffet was felt on the airframe". As the turn came to an end, speed was reduced to 190kt, with the angle of attack increasing to 15-16, and Merriman felt "a small pitching oscillation… Any attempt to stop it with use of elevator only aggravated the situation, but releasing the stick stopped it. If the speed dropped below 190 kts on finals a large power increase was required to prevent a further drop off and to restore speed. Once lined up with the runway, speed was reduced slowly and at 180 knots the attitude was becoming so nose high that the nose pitot boom was in the line of sight of the runway, and as the runway became nearer there was a tendency for it to be obscured by the nose of the aircraft. Eventually it was found that a good view of the runway could only be obtained with the seat raised fully, a position above the normal comfortable flying one, and with approach paths somewhat lower than the normally accepted 3°."

Of course, that would not have been practical when undertaking a ground-controlled approach. When a simulated GCA was rehearsed, "It was difficult to keep an accurate height and speed with throttle", owing to poor thrust response. While the engine rpm changed rapidly with throttle movements, no thrust change took place until the nozzle moved. The way in which large thrust changes occurred with little alteration in rpm, because the nozzle movements were large when compared with the effect on rpm, exacerbated the problem. "Control of the aircraft was good except for a tendency for a pitching oscillation to be induced by the pilot. It seemed impossible to get in phase with the motion and the nose could not be kept steady on the horizon because of it… Releasing the stick stopped it immediately."

◆

The sortie which employed the rocket experienced a glitch near its conclusion, when the hydraulic pressure read zero and the undercarriage refused to lower. Thankfully the emergency extension system worked and a safe landing was made. Touching down without the brake parachute, the port brake "did not appear to function very well" and there was a risk of a hard swing to the right, only counteracted by light starboard braking. By the end of the landing roll, "the brake units were extremely hot."

Merriman's overall assessment of the Mirage was very positive. He identified several areas that could be enhanced: better grouping and ganging of electrical switches "would cut down scramble time considerably", separating the air speed indicator and Mach meter would be "a great improvement", and cabin conditioning "was not very good". The tendency for pilot-induced oscillations below 200kt "became disturbing during take off and on the approach, and at high altitude it would constitute a limiting factor on weapon sighting". At any speed, the airbrakes "were relatively ineffective". And a normal fuel load in aircraft 01 allowed a dry-power climb to 36,000ft, acceleration in afterburner to Mach 2, a 180° turn and a further climb to 50,000ft, "by which time the fuel was down to an estimated minimum to carry out a let down and controlled approach". The Mirage's radius of action was considered "too small for satisfactory all weather operations". Various other flaws were also on his list, while Cockerill in particular felt nosewheel steering would be advantageous. But, those aside, the French fighter received a big thumbs-up.

"As flown", Merriman opined, the Mirage IIIA "was an extremely impressive aeroplane. It was obvious that great care and forethought had been used in its design and construction in order to produce an aircraft which was virtually foolproof and delightfully simple to fly. All the systems on the aircraft were automatically backed up when failures occurred so that the emergencies the pilot had to deal with were few and simple. The overall performance was very good; the supersonic performance being outstanding, but it was thought that the amount of fuel carried was rather marginal for all weather operations, and the climb in dry thrust was relatively poor. Handling was simple and straightforward both dampers on and off, but more development is required to eliminate the tendency to pilot induced oscillations at low indicated airspeeds. The hydraulic 'bob weight' seemed to be a successful solution to artificial spring feel on the supersonic aircraft.

> ***"The fuel carried was marginal for all-weather ops"***

"The good handling and performance coupled with great flexibility of role (eg drop tanks and bombs, various guided and unguided weapons, and the rocket motor pack were all quickly put on and taken off) and ability to operate from comparatively small semi-prepared landing strips on its low pressure tyres all go towards making it an outstanding aeroplane of its kind". Further development, said Merriman, would make it "one of the leading supersonic fighters in the world."

No attempt was made in this evaluation to compare France's new fighter with its British rival. But, with hindsight, one fact is undeniable. A total of 337 Lightnings were manufactured, and export sales to two customers achieved. The eventual Mirage III production run amounted to more than 1,400, and it was procured by 10 other nations. It didn't win the battle to bring a Mach 2 fighter into service, the first examples not reaching an Armée de l'Air squadron until July 1961, yet Dassault triumphed in the wider war.

THE AVON MIRAGE

Mirage IIIO 01 *City of Hobart* with the Avon engine fitted — it was a short-lived installation. DASSAULT

When the A&AEE delegation went to Istres at the beginning of 1960, Dassault was pinning its export hopes on a rather different Mirage III: equipped not with a French engine, but a British one. It was intended, Boscombe Down's report said, to fit a Rolls-Royce Avon to a single aircraft later in 1960, this giving 12,500lb dry thrust and 16,000lb with reheat, as opposed to the Atar 9C's 9,370lb dry and 13,200lb in afterburner. Climb and acceleration performance, it was predicted, would be considerably improved. In the event, just one example ever flew with power provided by an Avon. What happened?

The installation was made on the fourth production example of the Mirage IIIC variant to roll off the line, its engine being an Avon Mk67, otherwise known to Rolls-Royce as the RB167. As such, following a very rapid integration process it took to the air from Melun-Villaroche, south-east of Paris, on 13 February 1961, bearing the name *City of Hobart* and Royal Australian Air Force roundels as part of Dassault's effort to sell the Avon Mirage to the RAAF. The variant's designation was Mirage IIIO, the suffix selected by the manufacturer as 'O' for 'Ostralia' — no, seriously — since 'A' had been used on the pre-production single-seaters.

Dassault was championing the Avon-engined aeroplane over the Atar-powered derivatives as it considered the Rolls-Royce unit to offer the Mirage better export prospects. Australia, it hoped, would be the springboard for a lucrative campaign. The RAAF had considerable Avon experience from its earlier selection of the engine to power its Commonwealth Aircraft Corporation-built Sabres, and its operation of similarly powered English Electric Canberras. Surely, Dassault and the French government felt, this would help swing the deal and encourage others to follow, such as Switzerland, another existing Avon user through its Hawker Hunters.

The Mirage itself was selected for the RAAF during December 1960, but it left the engine choice open while further assessment — including flight-testing in France of the Avon-powered machine — went ahead. When the results came, they were surprising, at least to some. In *The RAAF Mirage Story* (RAAF Museum, 1990) by Wg Cdr Martin Susans, evaluation team member Guy Darling, as of 1960-61 a civilian engineer with the air force's Aircraft Research and Development Unit, is quoted as saying, "by early May, it was apparent that the expected advantages in take-off performance, rate of climb and range for the Mirage III with the Avon Mk67 engine were not a significant improvement over the Mirage IIIE [the version under consideration], whereas overall performance at altitudes above 40,000ft was somewhat inferior, although the Avon version was able to achieve higher speeds without afterburner at altitudes below 45,000ft."

There were broader considerations, too. SNECMA was due to produce a new variant of its engine, the Atar 9K, which would be much more powerful than the 9C and have lower fuel consumption. Against that, said Darling, "the development potential of the Avon Mk67 engine was limited to the fitment of a larger tail pipe [...] and the expected benefits to thrust and fuel consumption were not comparable with those available from the Atar 9K. The Atar engine offered additional important benefits, being lighter and cheaper than the Avon and was perceived to have benefits due to ease of manufacture and servicing together with simplicity of operation associated with design for military operation exclusively.

"It was also apparent that other potential purchasers of the aircraft were not contemplating acquisition of the Avon engine version and the enormous benefits of standardisation with other users, and particularly the French, made recommendation in favour of the Atar straightforward."

So, that was that. Selection of the Atar was confirmed on 17 May 1961, and when the 9K version was delayed, Australia decided to opt for the existing 9C. Its first Mirage IIIO was handed over at Melun less than two years later, on 9 May 1963. Switzerland, too, went for the Atar when it procured the aeroplane. Perhaps it seems tempting to consider the Avon Mirage something of a 'what-if', but the evidence of the RAAF evaluation seems pretty conclusive. And, contrary to what Dassault believed when the British team assessed its product, export success wasn't an issue.

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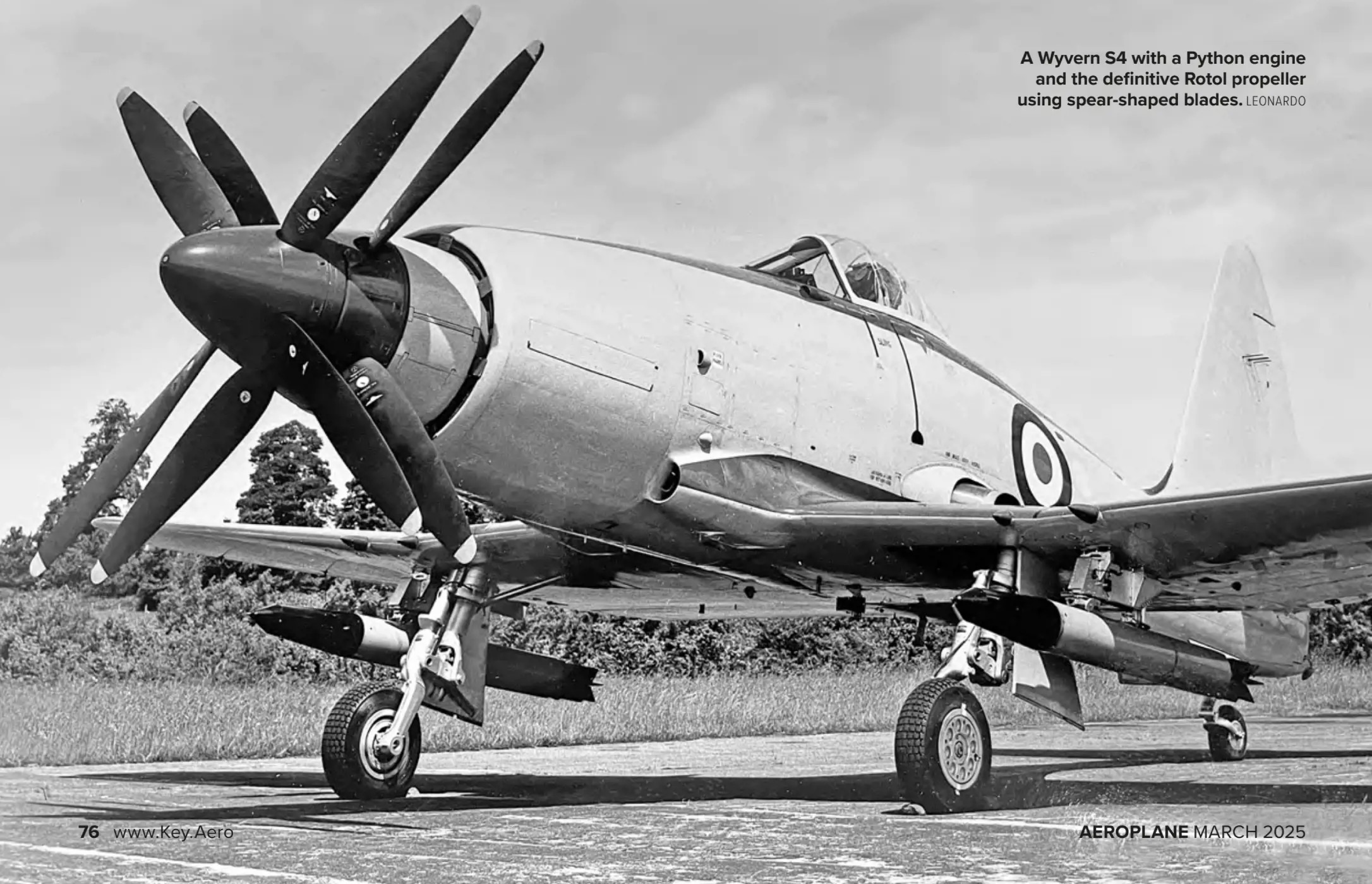
PROP FORWARD

Of all the features of Westland's Wyvern naval strike fighter, its contra-rotating propellers were not only among the most distinctive, but also crucial in obtaining the desired performance. How did their configuration and design come about? **WORDS:** NIGEL SCRASE

In 1944 the Naval Air Staff issued requirement N11/44, calling for a carrier-based, long-range, single-seat fighter-bomber. Although its primary role was to be aerial combat, the attack function would receive equal design priority. This involved the carriage of a torpedo or bombs, the latter to be delivered by dive-bombing. The Westland Aircraft Company had been busy producing concept designs for naval aircraft with contra-rotating propellers in 1943, under encouragement from the government. The favoured proposal to emerge from meetings with the Air Ministry and service personnel had a nose-mounted Rolls-Royce Eagle piston engine, and this became the Westland W34 project around which requirement N11/44 was written. Westland received a contract for six W34 prototypes, with Eagle engines rated at 3,500shp, in November 1944.

The W34 was born into a whirlwind of change in engine technology. This was a time of rapid transition in aero engines in the quest for greater power at lighter weights: from ever larger, heavier and more complex piston engines to pure jets and gas turbines driving propellers, otherwise called propeller-turbines or turboprops. The new turbines offered a huge increase



A Wyvern S4 with a Python engine and the definitive Rotol propeller using spear-shaped blades. LEONARDO

LEFT:
The first Wyvern prototype was TS371, which made its maiden flight from Yeovil on 12 December 1946, flown by Harald Penrose. KEY COLLECTION

in thrust/power per unit weight. While the initial prototype W34 was designed to use an Eagle, from the outset Westland had in mind the possibility of fitting one of the new turboprops. To suit this type of engine the layout of the W34's forward fuselage was redesigned, the result being designated W35. The initial choice of turbine engine was the R-R Clyde, the manufacturer's second turboprop, which demonstrated 4,200shp on test, but its poor availability caused a rethink by the Ministry of Supply and the 3,560shp Armstrong Siddeley Python — the first turboprop to emerge from its maker — was chosen instead. There followed a pre-production order, issued in 1948, for 20 aircraft with Python engines. The aircraft was officially named Wyvern in 1947.

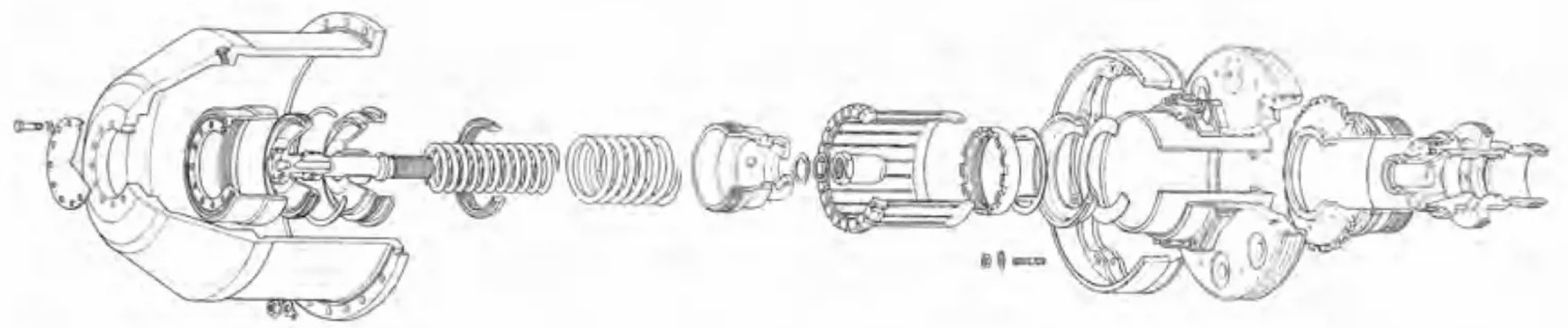
When comparing power between the Eagle piston and the turboprop engines it is worth remembering that turboprops also provide some thrust — in this case approximately 1,000lbf — which is additional to that from the propeller.

It was indicative of the era that even as the piston-engined prototype was conducting flight trials in 1946, Westland produced a design for a pure jet version of the W34/W35, which would have leapfrogged the turboprop. Several different turbojet engines were considered, but no jet-powered variants got off the drawing board.

As the Wyvern would operate from aircraft carriers, it needed the usual special design features associated with this role: an undercarriage optimised for heavy landings, an arrester hook with a strengthened aft fuselage, a catapult attachment, good pilot visibility for carrier approaches, and folding wings. It also required very good low-speed handling characteristics for deck take-offs and landings, with predictable and rapid thrust control.

The naval N11/44 requirement called for a maximum speed of 500mph at 20,000ft, a cruising speed of more than 340mph and an endurance of three-and-a-half hours including combat. Its demanding payload/range and speed parameters, and the need to fly from carriers, led to a design that was both large and heavy, necessitating very high installed power. This would require a

LEFT:
Aboard HMS *Illustrious* in 1949, Eagle-powered third prototype TS378 sports three-bladed de Havilland propellers. ALAMY



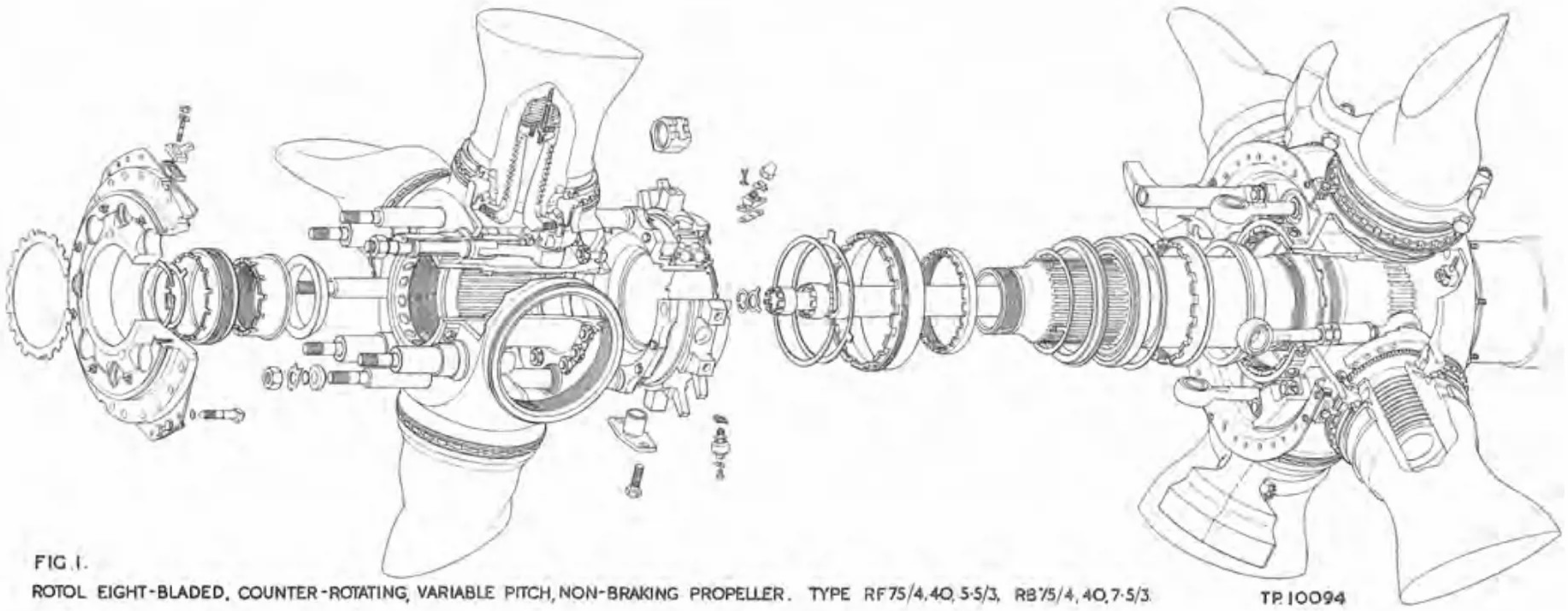


FIG. I.

ROTOL EIGHT-BLADED, COUNTER-ROTATING, VARIABLE PITCH, NON-BRAKING PROPELLER. TYPE RF75/4,40, 5·5/3, RB75/4,40, 7·5/3.

ABOVE: An exploded diagram of the Python-powered Wyvern Mk2 propeller hub. DOWTY PROPELLERS

propeller capable of handling that power and delivering great efficiency at high speeds, but which would be limited in diameter.

The company selected to provide the propellers for the Wyvern was Rotol. It was clear a contra-rotating arrangement, as opposed to a single-rotation propeller, was vital. When the disc power loading (power divided by disc area) is high, as was the case for the Wyvern, contra-props offer higher propulsive efficiencies than single-rotation propellers for a given propeller diameter. This is due to the recovery of swirl energy from the front rotor, which is greater at high disc power loadings. This greater efficiency is maintained to higher air speeds than is the case with a single-rotation propeller. A corollary of this is that a smaller diameter, typically by 10 to 15 per cent, can be used with a contra-prop for the same efficiency.

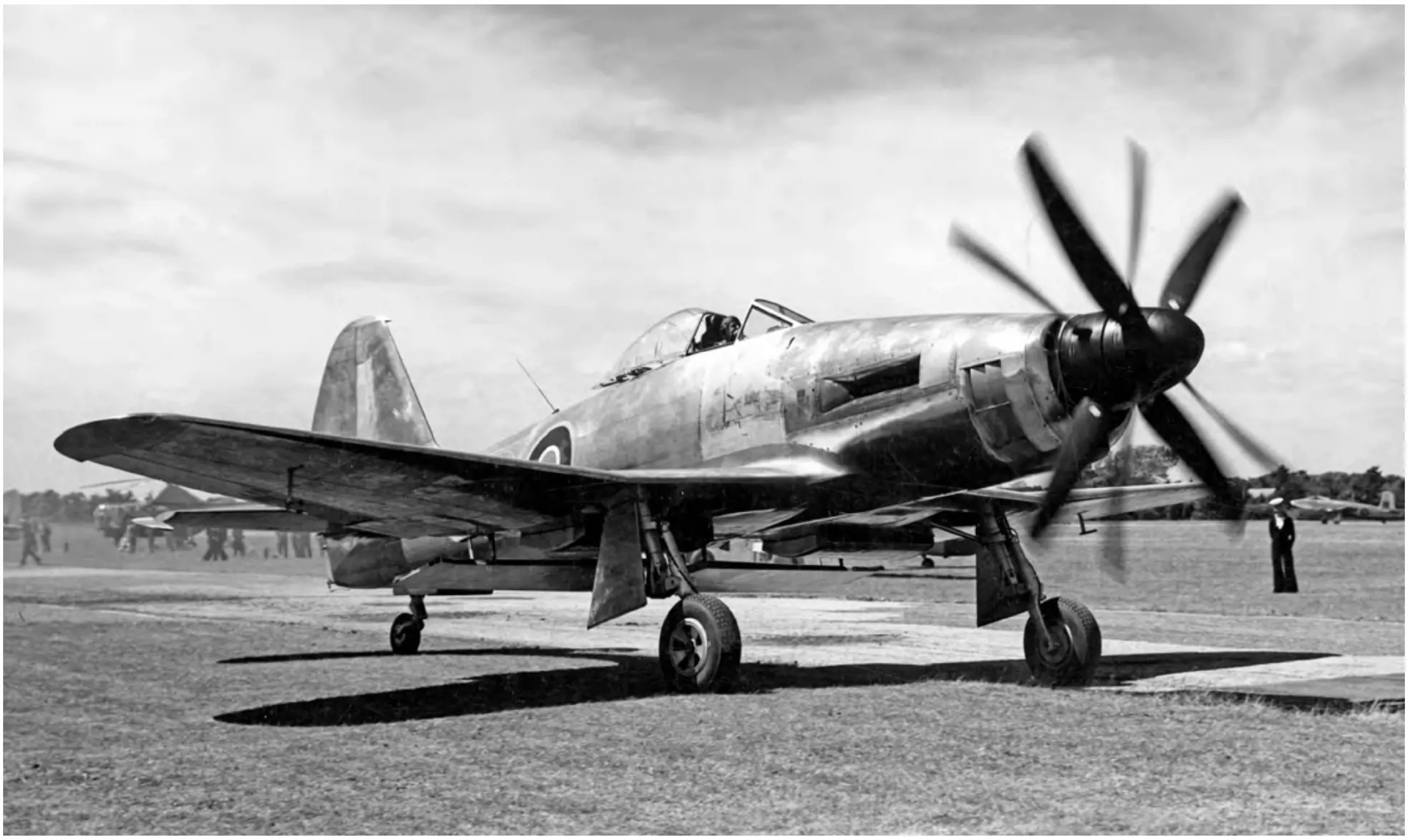
If this was not compelling enough, the high installed power on the Wyvern probably required eight blades. Fitting eight blades into a single-rotation propeller would have resulted in a very large and heavy hub. Five blades in one hub were the most Rotol had used to date.

The Wyvern's propeller diameter was limited by many interacting constraints. The undercarriage had to be long enough to allow for a large prop diameter with adequate deck clearance during the take-off run, and short enough when retracted to allow carriage of a torpedo on the centreline. However, the span-wise mounting point of the undercarriage — and hence its track — was limited by the folded width of the wings, which was dictated by the ships' lift and hangar dimensions. That the propeller diameter was not overly compromised was due to the Dowty design whereby the undercarriage shortened itself prior to retraction and lengthened during deployment. They must have considered using anhedral on the inboard wings, as on the Fairey Gannet!

> **“It was clear a contra-rotating arrangement was vital”**

One can imagine the design trade-off calculations that could have been performed when choosing the propeller diameter: an increased diameter would give increased efficiency, leading to reduced fuel burn, but it would come with greater propeller and shaft weight, and a higher undercarriage weight, all offsetting the fuel savings. This was in the days when the calculation of propeller efficiency for just one operating condition took days, whereas now it takes seconds. In such circumstances — and in wartime — the value of applying extensive engineering knowledge, experience and judgement for reducing timescales and costs cannot be underestimated. It was decided to have a 13ft (3.84m)-diameter contra-prop with four blades per row.

The other considerable benefit of a contra-prop, compared with a single-rotation propeller, is the massive reduction of swirl in the propeller wake. This greatly enhances low-speed handling qualities and safety during carrier take-offs and landings. Additionally, contra-props virtually eliminate the steady torque reaction on the airframe, and propeller-induced gyroscopic effects such as pitch and yaw coupling during manoeuvres. The steady pitching and yawing moments that come from a propeller during flight at high angles of attack and sideslip are banished too.



ABOVE:
Harald Penrose taxies out in TS371 before displaying at a June 1947 Lee-on-Solent open day. The aircraft was lost in a fatal accident that October, test pilot Peter Garner being killed when it crashed near Cattistock, Dorset due to a propeller pitch bearing failure.
AEROPLANE

However, contra-props are not all good news. The additional shafts and gearing add weight, as does the extra blade actuation mechanism, and the greater mechanical complexity increases the technical risk. This can result in longer development and higher costs.

Contra-props started to take to the air in the 1930s, but as of 1940 there was very little knowledge and data available to help engineers with their design and development. Rotol embarked on the development of its own contra-prop designs during World War Two, initially with three blades in each row, intended for the later marks of Spitfire. However, due to development problems these propellers only entered production as the war ended and were fitted to the Seafire Mk46/47 instead. de Havilland also developed contra-props, and one was fitted to an Eagle-powered Wyvern prototype, TS378, for a while.

The Wyvern's Rotol propeller was the first eight-bladed contra-prop to be conceived in the UK, and the Python was Armstrong Siddeley's first turboprop engine. No-one in the UK had designed and developed a turboprop aircraft to operate from carriers, so Westland was breaking new ground, although the Fairey Gannet was not far behind. When the W34 took to the air in December 1946 it was powered by the Eagle, the last R-R piston aero engine to be developed before it made the switch to gas turbines. The maiden Wyvern flight with the Python turboprop occurred in March 1949.

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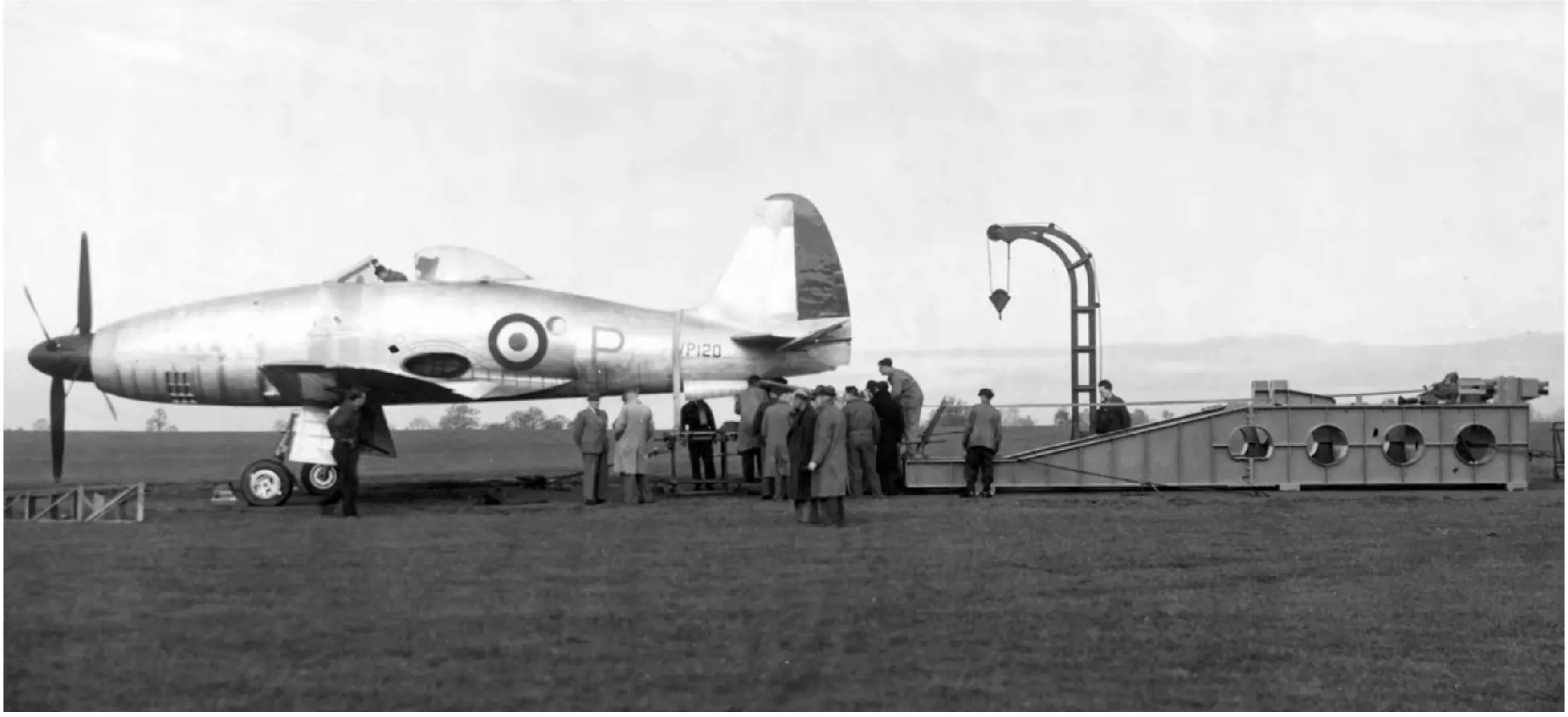
The recipe was therefore in place for yet more technical challenges to come. The main issues were to do with the engine/propeller control system. As a result, Wyverns were still not cleared for carrier operations by December 1952, being restricted to shore-based flying until the definitive control system was fitted to Wyvern S4s which then embarked on HMS *Albion* in September 1954. Unfortunately, this deployment highlighted engine flame-out problems during catapult launches. All these matters were overcome.

The starting-point for the aerodynamic design of propeller blades is to decide upon the flight conditions at which to optimise the design for best efficiency. For the Wyvern, as a carrier-based fighter, the design conditions in order of priority would be maximum speed, climb, cruise and take-off. These, indeed, are in the sequence given in the N11/44 requirements.

Having take-off last would seem ridiculous given the deck length limit, but perhaps it was due to the aircraft being catapult-launched. However, Westland performed tethered aircraft thrust measurements using VP109, with a Python 1 engine, and VP113, where it tried different ways to increase the static thrust. It was found that increasing the propeller rpm from 1,016 (gear ratio 0.127) to 1,080 (gear ratio 0.135) raised the thrust from approximately 8,000lbf to 9,000lbf. The 0.135 gear ratio was adopted for the Python 2 onwards.

A strip analysis method is used for blade design and analysis, meaning the local aerodynamic conditions are analysed at specified radial locations along the blade. To design a blade, the first step is usually to decide upon the thickness-to-chord (t/c) ratio for the aerofoil sections to be used at these radial locations. This is done with a first-guess chord distribution in mind, so the thickness of the blade along its length will be sufficient to withstand the flight loads, based on experience. For high-speed applications, thinner aerofoils will be needed, so the high helical tip



ABOVE: Thrust measuring trials being performed at Yeovil on Rolls-Royce Clyde-powered Wyvern TF2 prototype VP120, which used Rotol props. ALAMY

Mach numbers — Mach 0.85-0.95 for the Wyvern — did not adversely affect aerodynamic performance.

Then, for each radial station the camber of the aerofoil can be chosen to give the best possible lift-to-drag (L/D) ratio for the local Mach number at that station. With this information the blade twist and chord distribution can be optimised so each aerofoil operates at its best L/D ratio, the lift distribution along the blade is as close to optimum as possible, and the propeller absorbs the specified power. The blade pitch angle, thrust and efficiency are outputs from the process. The mathematical model predicts the in-flow velocities, induced by the lift, at each radial station along the blade, giving an accurate calculation of thrust and efficiency. The final aerodynamic twist and chord distribution will be a compromise that ensures all the high-priority design cases have good efficiency.

The final geometry for manufacture involves further compromises to satisfy, in detail, structural and manufacturing considerations. One important aspect of this is the stacking of the aerofoil sections along the blade to introduce lean or sweep to it. Leaning the blades in the direction of the local lift vector reduces the root bending moments by virtue of the centrifugal loads. Sweep improves aerodynamic performance at high Mach numbers but was not necessary for the Wyvern, although it's quite common these days.

For a contra-prop there is the added complication of the interference velocities between each row of blades, and the mathematical model takes account of all that. This leads to the design of the rear row blades having, as a minimum, a slightly different twist distribution to the front row. The model also tells the hub designer what blade pitch angle difference is required between the two rows of blades to obtain the best performance. In a conventional contra-prop this is then set mechanically within the hub. Typically, the rear row of blades is set at a slightly lower pitch angle.

> *“The spear-shaped blades were introduced in the Wyvern S4 upgrade”*

To any observer the planform shape of the blades is most evident — in other words, the chord distribution. Blades designed to absorb a lot of power will be wider, especially towards the tip. The technical parameter that relates the blade shape to its power absorption capability is the activity factor (AF). Rotol designed two different sets of blades for the Wyvern. The Eagle-powered variant used an AF of 98.5, giving paddle-shaped blades. It is likely these were meant to cater for the Clyde engine's 4,000shp rating. The Python-powered versions ended up using an AF of 80.4, giving slimmer, spear-shaped blades. In both cases it seems the AF for the front and rear rows was the same.

The spear-shaped blades were introduced in a suite of aircraft modifications to bring them up to Wyvern S4 standard, with the Python 3 engine, in 1950-51. It has been reported that this change of blades was made to reduce the root bending moments, and not for aerodynamic reasons. However, when comparing the Eagle/Clyde propeller blades with the Python 3 blades it is evident that the reduced power and increased rpm of the Python compared with the Clyde did warrant the aerodynamic change to a slimmer blade planform, because the torque loading per unit blade area is similar for both designs.

In the 1940s and ’50s the process used for design would have been quite laborious because of the lack of computing power available. The design calculations for the Wyvern propeller would have been performed by teams of people operating mechanical calculating machines, slide rules and seven-figure logarithms. This was a slow job, requiring days to solve the equations for a single blade pitch angle of a single-rotation propeller, and severely limiting the refinement of any design. From the early 1950s electro-mechanical and then electrical calculating machines were introduced, which sped things up. The first use of a computer — an Elliot 402E valve machine — for propeller aerodynamic design and analysis at Rotol was in 1959, far too late for the Wyvern. This reduced calculation times by a factor of 300 compared with the wartime era.

Prior to 1949 each propeller manufacturer had its own method for predicting propeller efficiency for a given design. It was not until the SBAC Standard Method was introduced in 1949 that UK industry could use a generally recognised baseline, so aircraft manufacturers could compare different designs on the same basis. The lack of a common, agreed method contributed to uncertainty about aircraft performance predictions. While developing the W34 in 1944, de Havilland offered an efficiency of 76 per cent with its propeller design and Rotol 82 per cent for its — both 12ft 6in-diameter, eight-blade contra-rotating props, at 480mph. These days it would be rare to find such a large difference in predicted efficiency between propellers designed by different companies for the same requirements. Incidentally, it's worth noting that the SBAC method was not a design method, but a performance analysis method.

During the war all Rotol's blades were made from laminated wood. Duralumin, an aluminium/copper alloy, was in short supply, and magnesium had fallen out of favour. In the USA hollow steel blades were used, but Rotol viewed these as being too heavy and difficult to repair. As hostilities ended, the supply of duralumin improved, so the Wyvern blades were made by profiling solid duralumin forgings.

The aerofoil sections used for the Wyvern blades were chosen from the NACA 16 series family of aerofoils, and the Rotol blades had a t/c at 70 per cent radius of 7.6 per cent. At the highest speeds envisaged for the aircraft the helical tip Mach numbers would have been in the region of 0.95 at 35,000ft altitude, so thin aerofoils were necessary. NACA 16 aerofoils were designed to avoid transonic flow problems and developed in the late 1930s in the USA. They were first used by Rotol in the propeller for the Supermarine Spiteful in 1944 and then for the Wyvern and all subsequent turboprop designs until the mid-1970s, when Dowty Rotol developed its own family of aerofoils.

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The Rotol propeller used on the Python-powered Wyvern was 13ft in diameter, contra-rotating with four blades in each row, turning at 1,080rpm for take-off and 1,053rpm for cruise, with an activity factor of 80.4. Unfortunately, it has not been possible to locate data for the efficiency of this propeller, but it is likely to have been between 85 and 90 per cent at the high-speed design conditions.

Its static thrust would have been in the region of 9,000lbf, including 1,100lbf residual thrust from the Python 3 engine. This would give the Wyvern S4 an initial acceleration in still air of 0-60mph in 7.4 seconds, when fully loaded with a torpedo — quite sluggish, illustrating the need for catapult assistance.

The two hubs, one for the front blade row and one for the rear, were machined in-house at Rotol from a steel forging delivered to the company. The hubs were single-piece units, as opposed to two halves bolted together, so the blades were made to be individually removable by unscrewing a large castellated nut and withdrawing the blade with its double-row taper roller

Photographed in May 1950, VW867 was the first in the pre-production batch of Wyvern TF2s. *AEROPLANE*

These Wyvern S4s hail from 813 Naval Air Squadron, the first operational unit to receive the type when it took delivery at RNAS Ford in May 1953. AEROPLANE

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bearing from the blade port. This simplified maintenance and repair of the blades. The roller bearing enabled blade pitch changes over a range of 78.75°, from fully coarse (feather) to fully fine (engine starting).

The splined drive shafts engaged with splined drive centres inside the hubs. Each hub was centred onto the shaft by a pair of centring cones and secured in place by castellated nuts which screwed into the front of each shaft and into the front of each hub. In other words, there were no drive flange attachments.

An important feature is that there was only one blade pitch actuator for both rows of blades, so whatever pitch angle changes were commanded by the control system were fed to both rows simultaneously. This simplified the design. The increased complexity and weight that would be entailed in having independent control systems and actuators for each blade row is not usually warranted by propulsive efficiency benefits, or by the extra functionality it might offer. Although there is a single actuation system, a permanent offset between the blade pitch angle of the front row and the rear row blades is needed. This is common practice and reflects the fact that the rear row sees a different onset flow to the front row. The offset will have been determined as a best compromise over the aircraft's speed range and was set at 0.75°.

> ***"The Wyvern propeller was a major achievement"***

The pitch change actuator was a hydraulic ram mounted on the front hub, with a fixed cylinder and a translating piston. The oil supply for this came from the engine lubrication system, and was pressure-boosted. It entered and exited the cylinder via a pair of concentric oil tubes that ran inside the shafts. The piston drove the pitch of the front-row blades directly and the pitch of the rear-row blades via four connecting rods that went through the front hub to a translating bearing between the rows. The inner race of this bearing was driven around by the front hub, and the outer race in the opposite direction by the rear hub. Fore-and-aft translation of the bearing drove the pitch of the rear-row blades.

Flexure of the shaft driving the front propeller was found to be excessive on the Eagle-engined prototype. It can be imagined that flexure of the front shaft relative to the rear could put undue strain on the translating bearing. Lubrication of the ball race within it turned out to be problematic, and it was a failure of this bearing that caused the crash of TS371 in October 1947, killing Westland test pilot Peter Garner.

The rear row of blades was fitted with counterweights. The function of these was to reduce the forward axial load on the translating bearing due to the centrifugal twisting moments of the front and rear blades. This also lessened the load on the hydraulic actuation unit. The propeller weight — including spinner and controller — was 1,145lbf, which represented 20 per cent of the whole powerplant weight.

The Rotol type register from this era shows that many variants of this propeller were designed, most of the differences being in the control units and not the blades or hubs. Rotol delivered 250 front and rear units for the 127 Wyverns built.

This was not the last contra-rotating propeller designed by Rotol, because it also supplied that for the very successful Fairey Gannet, powered by Armstrong Siddeley's Double Mamba. This was a co-axial propeller, meaning two independent propellers rotated on the same axis, each driven by a dedicated engine so one engine and prop could be shut down in flight.

In the UK, interest in contra-rotating and co-axial propellers waned after that, until the 1980s when high fuel prices urged R-R and Rotol to join forces to design and wind-tunnel-test advanced open rotors (AORs) for commercial airliners. Rotol performed parametric studies during that decade for contra-rotation and single-rotation propellers designed for fuel-efficient air transports having high speed requirements.

The Wyvern propeller was a major achievement by Rotol, initially designed during wartime and readied for its first flight in 1946, in an era without computers. Nothing seemed impossible, except perhaps for using it as a dive brake.

As for the company itself, Rotol was bought by Dowty in 1960 and changed its name to Dowty Rotol. Since then, the company has been through a few more changes of ownership — Tube Investments, Smiths Industries — and it is now in the hands of GE Aerospace, trading as Dowty Propellers and operating from the former Gloster Aircraft Company site at Hucclecote in Gloucester. The ownership may have changed, but the excitement of the engineering challenges has not.

The author thanks Nick Bown of Dowty Propellers and Jerry Graham of Leonardo Helicopters.

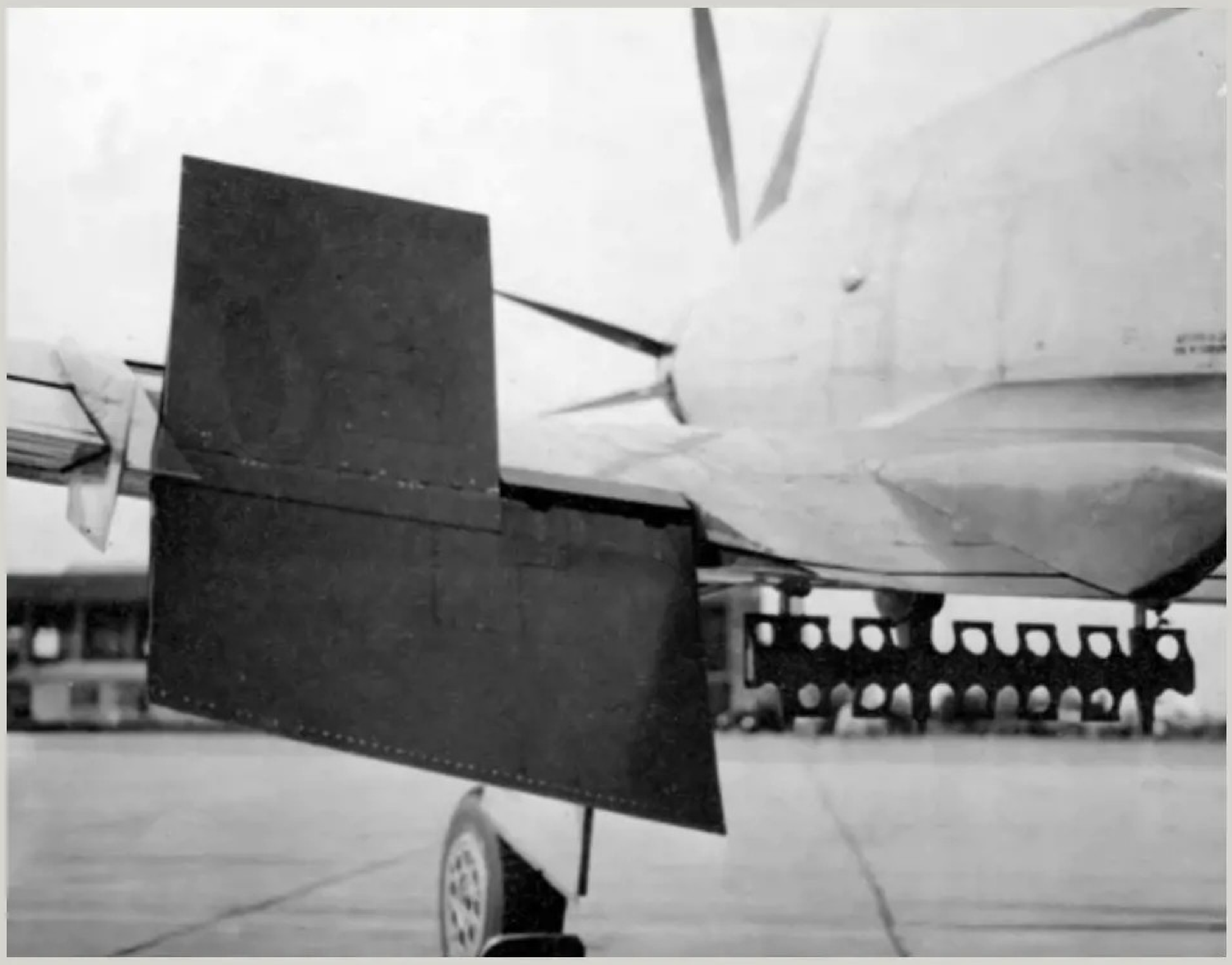
APPLYING THE BRAKES

From the outset, one of the navy's requirements in N11/44 was for the aircraft to be used for dive-bombing. This called for two dive conditions: a 60° dive at 350-380kt, and a 70° dive at 435kt. The requirements also stated the propeller should be considered for use as a dive brake, the attraction being that it might enable modulation of the drag via blade pitch control and there might only be a small weight penalty in doing so.

Early discussions with Rotol must have revealed serious doubts about this idea because a dive brake was fitted to the upper surface of the outer wing on the second — Eagle-powered — Wyvern prototype, TS375, in late 1947-48, although flight-testing by the A&AEE in 1950 concluded these airbrakes were not sufficiently effective.

Rotol calculated in 1951 that the dive requirements would require a drag increment from the propeller, if used as the only dive brake, in the region of 17,000lbf (7,710kgf) for both dive conditions. The basic principle for creating propeller drag in flight is to reduce the blade pitch angle so the blades no longer produce thrust, and instead produce negative — or reverse — thrust, otherwise referred to as drag. However, to produce reverse thrust when flying at high speeds the blades must enter the angle range where they develop a lot of power rather than absorbing it — they will 'windmill'. In this region there is an acute danger of over-speeding the whole powerplant system.

Rotol performed a great deal of analysis in 1951-52, trying to find a solution to the problem of enabling the propeller to achieve the required drag in a safe way for the aircraft. Three design options were assessed: fining all the blades in both rows by using the conventional pitch change mechanism of a single actuator and control system, using the translating bearing between the two rows; fining the blades in the rear row only by having a separate actuation and control system for the rear row of blades; and fining only half the blades in each row by having a separate control system for these four blades.



The final dive brake solution on the Wyvern S4, showing the later addition of the perforated dive brake beneath the wing. CROWN COPYRIGHT

For the first option, with all eight blades put into the braking condition, Rotol chose a blade angle of -4°, because this avoided over-speeding and stalling of the engine for steady speeds up to 380kt. However, eight blades set at -4° generated so much drag it would limit the aircraft speed, at any angle of dive, to a steady 280kt — far below the minimum requirement of 350kt. This was unacceptable. Another disadvantage of this concept was that there was no means to control the propeller drag and torque once the blades were set at this angle.

Option two was then assessed. In this concept, only the blades in the rear row would be used for braking. It was found a blade angle of -15° for the rear blades would generate a suitably large amount of drag in the dive. Interestingly, at -15° the rear-row blades would be absorbing power which means the front-row blades would need to develop power (windmilling) to balance the torque and control the rpm. The front row would remain in constant speeding mode, controlled by the constant speed unit, automatically controlling the rpm of the whole system by continuously adjusting the front row blade angles. This option offered controllability in the dive, but it would obviously require a separate control and actuation system for the rear-row blades.

The behaviour of the propeller during entry into and exit from the dive required special attention so over-speeding would be avoided. Rotol performed time-based simulations to determine the likely rpm behaviour and to look for solutions to the problems found. A governor sensitive to angular acceleration, instead of speed, was proposed. This was predicted to be a success.

It was therefore felt a braking propeller could be designed that provided the necessary drag, fulfilling the requirements for dive speeds and angles, and safely controlled to protect the engine and propeller in dive entry and exit. However, a contra-rotating propeller being used as a dive brake in this way, where one row of blades generates power and the other absorbs power, would create a large torque reaction on the engine mountings — significant in a steady dive. This would be unacceptable. Therefore, a decision was made for the rear-row blades to be set at -4° instead of -15°. At this angle neither blade row would be absorbing or developing any torque.

It was looking as though Rotol had at last found an aerodynamic solution, but there was a sting in the tail. During the dive entry and exit transitions, as the blades in the rear row move to or from -4°, they would develop a large quantity of power through windmilling such as 5,000shp, while the front row would need to absorb this power to govern the rpm. Unfortunately, this meant the swirls in the propeller wake generated by each blade row would be large and additive, and as a result the aerodynamic loading on the Wyvern's fin would exceed the design limit.

Rotol had one last idea up its sleeve. In this design, two blades in each row would be reversed for the dive. This would eliminate the swirl in the propeller slipstream under all conditions, but Rotol concluded, "vibration troubles would make this impracticable". The mind boggles at the complexity of the system needed for this functionality.

It therefore appears the braking propeller idea finally died in 1952. Ultimately, after in-service experience, Wyverns were fitted with additional dive brakes beneath the inner wings. These were perforated plates, mounted on the main wing spar. Flight-testing of this configuration on a Wyvern S4 was undertaken by the A&AEE during the summer of 1953. It was found that in addition to the existing dive brakes on the outer wings, the underwing brakes gave satisfactory dive performance, enabling the naval requirements to be met.

It is surprising so much work was done on the braking propeller and that the much simpler solution of using conventional dive brakes with sufficient area was not implemented sooner. However, Rotol's innovative efforts in 1951-52 on the braking propeller idea did not delay the Wyvern programme: it was completed while serious problems with the engine/propeller control system were being tackled.

Mike Lithgow as he's best remembered, in the cockpit of Swift F4 WK198 at Chilbolton before setting off for Libya and his successful attack on the world air speed record. GETTY

A VERY BRITISH HERO

Attacking the *Bismarck*, setting a world air speed record in a new jet — the highs in Mike Lithgow's flying career are, rightly, the stuff of legend. Alas, it came to a tragic end. What placed him in the pantheon of British test-flying greats? **WORDS:** STEPHEN SKINNER

The Swordfish of 820 — sporting codes starting with 4 — and 821 Squadrons running up on HMS *Ark Royal* before the strike against the *Bismarck*.
VIA MATTHEW WILLIS

In mid-1953 Supermarine and its chief test pilot, Mike Lithgow, decided the time was right to tackle the world air speed record, held by the North American F-86 Sabre. There was plenty of competition. Before Supermarine could make an attempt its major rival, Hawker, took the title on 7 September. According to Lithgow in his autobiography, *Mach One*, "the 727mph achieved by the Hunter [...] did not unduly concern them", so preparations continued.

Whereas Neville Duke's Hunter record had been set along the Sussex coast, Supermarine went to Libya where, owing to the high temperatures, the aircraft could achieve the highest speed in terms of miles per hour. Les Colquhoun, one of Mike's test pilot colleagues, took a team out there to conduct a survey. Idris airfield near the Mediterranean coast was adopted as a base and a 10-mile-long, straight road 50 miles south of Tripoli would be the course.

The Swift chosen, WK198, was originally built as an F1 but was converted into the F4 prototype with a reheated, 9,500lb-thrust Rolls-Royce Avon 114 engine. Taking part in the Queen's Coronation Review flypast at RAF Odiham on 15 July 1953, WK198's Avon suffered compressor failure during a 670mph run-through at 700ft. Mike had to trade speed for height and make another of his brilliant power-off landings at the company's test aerodrome at Chilbolton, 21 miles away.

Prior to setting off for Libya, Mike had been flying WK198 and Dave Morgan the Swift F3, WK195, at the Farnborough show every day. Both wowed the crowds with their formation supersonic dives followed by 700mph flyovers about 10ft above the ground. Afterwards, on 13 September Mike made the 10-minute flight in WK198 back to Chilbolton where it was prepared for the Libyan deployment.

Taking off on 22 September, accompanied by Les Colquhoun in Attacker WK286, Lithgow flew to Tripoli's Idris airfield via Nice and Tunis, arriving later that day. Measurement of the speed record attempt was to be undertaken by representatives of the Royal Aero Club, who were transported to Libya — along with Supermarine's groundcrew — in a Handley Page Hastings.

The body overseeing these records, the Fédération Aéronautique Internationale, stipulated that the aircraft had to make four runs within 30 minutes over the 3km course, no higher than 500m. Orbiting well above Mike in the Attacker, Colquhoun was on hand to relay any messages to the low-flying Swift. So as to satisfy the height rules, Supermarine stationed a Gloster Meteor and an

Avro Anson at the ends of the course carrying Royal Aero Club observers to check Lithgow was not too high. Helping them spot the light blue WK198, its nose and jet pipe were painted black.

Mike wasted no time. According to his logbook, his first attempt came on 24 September when he was in the air for just 25 minutes. His autobiography cites it as taking place the following day. Despite a lot of turbulence, the run gave a particularly good result of 737.3mph, later reduced to 735.7 owing to a camera timing malfunction.

Libya was extremely hot in late September and Lithgow had to endure exceedingly high temperatures as the Swift's air conditioning was in an early stage of development. To counter the effects Mike wore a ventilated suit cooled by dry ice supplied by the Walls ice cream company. As he climbed into the cockpit 30 minutes before each flight he was pleasantly chilled. Once airborne the temperature soon rose to above 80°C, so on landing he found the ambient 40°C of the desert very cooling. In the introduction to Mike's autobiography, Charles Gardner — who was at the record attempts — wrote, "I shall never forget Lithgow standing in an office in the Swift hangar at Idris airfield just after he landed. He was wearing only pants and socks, while sweat rolled in rivers down his face, arms and body. One hand held a bottle of lemonade and in the other a cigarette."

> ***"Sweat rolled in rivers down his face, arms and body"***

On the 25th he made two more runs, and three the following day where two of them gave an average speed of 743mph but on the third the reheat failed to ignite. There were many other problems: turbulence, a sticking oxygen valve that forced Mike to tear off his mask at 750mph and 100ft, and a fuel gauge failure. A three-day break owing to a southerly wind off the Sahara, which whipped up sandstorm after sandstorm and caused very low visibility, kept WK198 grounded until a single effort on the 28th. Two further flights took place on 2-3 October. After each the Swift was put into a hangar where, Lithgow wrote, "it gently sizzled and crackled away to itself for an hour or so. The paintwork in some places was blistered and blackened…"

On the other side of the Atlantic the Douglas F4D Skyray naval fighter/interceptor was practising to take the record, so Supermarine decided it was best to send in its claim for the first runs to the FAI, even though it kept on trying. The Swift was subsequently awarded the air speed record for its flights on 26 September.

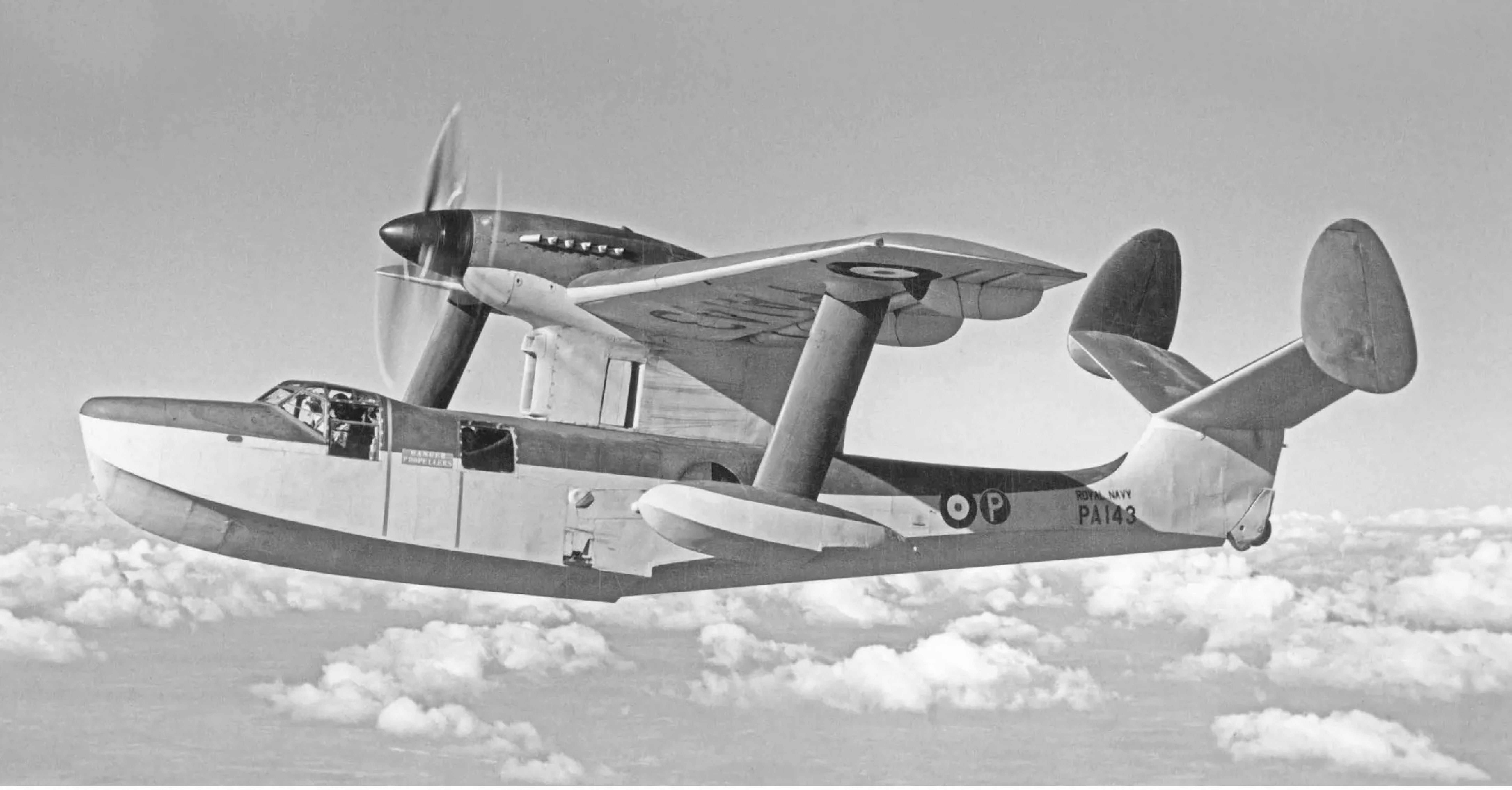
By the time Mike flew back to Chilbolton on 8 October, WK198's record had already been beaten. The Skyray had achieved 752.9mph, but only 26 days later that too was surpassed by the North American F-100 Super Sabre. Mike had a week off flying on his return and then resumed the Swift test programme, trying to help solve its many difficulties. Naturally he reported to *Flying Review* magazine that everything had gone smoothly.

Transitioning to the Albacore with 820 Squadron — this is one of its examples — brought its difficulties. VIA MATTHEW WILLIS

No question about it, Mike Lithgow had the 'right stuff'. He possessed the unerring skill to test high-performance aircraft in the air, a necessity in a period when, unlike today, so little could be simulated or safely evaluated on the ground. And as a prominent figure in his world during the 1950s, he achieved something approaching modern celebrity. He was so well-known that he was pictured in an advertisement endorsing Capstan Navy Cut cigarettes. When the talented director David Lean crafted a film about British test pilots and the quest for speed, *Sound Barrier*, the Supermarine 510 starred as the 'Prometheus'. Guests at the premiere included Frank Whittle, Douglas Bader, Mike and his wife Dorrie, plus his Supermarine pilot colleagues.

Michael John Lithgow was born on 30 August 1920 and educated at Cheltenham College. Flying was in his blood, as his father had been a pilot in the Royal Flying Corps during the First World War, having passed through one of the first Central Flying School courses in 1912. Having joined HMS *Frobisher*, a cadet training ship, at Fareham as a midshipman in March 1939, that June he was sent to No 20 Elementary and Reserve Flying School at Gravesend where he underwent intensive training in DH Tiger Moths. From there he was entrusted to the RAF for advanced flying training at Netheravon, where he received instruction on North American

The first ever Spitfire Trainer, MkVIII N32, was flown by Lithgow before anyone else.
BAE SYSTEMS



ABOVE: At the helm of Seagull ASRI PA143, the first all-new aircraft type of which Mike made the maiden flight. *AEROPLANE*

Harvards and Fairey Battles, and was graded on 10 November 1939 as an 'average' pupil pilot. Awarded his wings in mid-January 1940 he began specialised training at Gosport to become a naval pilot, flying the Fairey Swordfish or the Blackburn Shark, and rated 'proficient'.

Lithgow writes in *Mach One*, "In early war years a Swordfish could be induced to proceed at 110 knots [...] but later, when every conceivable device for the successful conduct of the war was hung in or on it [...] 85 knots became a more usual speed". Tuition also covered bombing, reconnaissance, navigation, depth-charging, and finally catapult take-offs and deck landings.

With the fall of France Mike went through the fighter school course at Eastleigh, training on 759 Squadron's Gloster Gladiators, Blackburn Skuas and Rocs. There was still a great fear of invasion when he joined 818 Squadron, flying Swordfish and based at Thorney Island. They were sent out to cover Blenheims on bombing missions and were about to move to Jersey, only to be stopped at the last minute by the news of its occupation by the Germans. 818 embarked in June on HMS *Ark Royal*, which went to join Force H off Gibraltar.

Lithgow had moved to 820 Squadron by the time of a career-defining episode. When the German battleship *Bismarck* and cruiser *Prinz Eugen* set forth from a Norwegian fjord on 21 May 1941, the German fleet was soon engaged by HMS *Hood* and HMS *Prince of Wales*. Within minutes the *Hood* was hit; its magazine exploded and only three crew survived. The *Prince of Wales* withdrew damaged, but *Bismarck*'s fuel bunkers were hit and so it headed for France. Mike wrote, "It fell to my squadron to make the first strike… The weather was such that in normal circumstances we would have remained on deck. On 26 May, there was almost a full gale blowing, and cloud was down to 4,000 feet."

◆

Climbing above the cloud, after an hour they made radar contact and dived for a beam attack on the vessel. However, it was not the *Bismarck* but HMS *Sheffield*. Recognising this, Lithgow and other pilots fired red Very flares to halt the strike. Some Swordfish pressed home their attack in the stormy conditions but their torpedoes all exploded after travelling a few hundred yards as the magnetic pistols malfunctioned in the prevailing sea conditions, so the *Sheffield* escaped unscathed.

After two hours 20 minutes in the air, Mike's squadron returned to the *Ark Royal* where there was a further hazard in store. The sea state was worse. Mike recalled, "The rise and fall of the stern was distinctly alarming — it was [...] found to be 56 feet… we smashed the undercarriage of three aircraft in the process of landing-on. As each aircraft landed its wings were folded, and it was struck down into the hangar below, where torpedoes — this time with contact pistols — were reloaded with all possible speed."

The squadron battled into the air again, some Swordfish slithering sideways as the *Ark Royal* rolled, but all made it off. They set course for the *Bismarck* which fought back against their attack, peppering the sky with flak. Mike saw no hits made and flew back to the *Ark Royal* after over three hours in the air. However *Bismarck* was hit in the stern and its rudders were critically damaged. The next day the squadron's Swordfish were airborne and watched the battleships HMS *King George V* and *Rodney* pulverise the *Bismarck*, which was eventually sunk by torpedoes from a cruiser.

820 Squadron was ordered back to Britain in July 1941 to convert to the Fairey Albacore, and spent the remainder of the year training on the type. The Albacore boasted an enclosed cockpit with central heating and a reasonably effective toilet system, besides which it was much faster. Despite these 'mod cons', Mike disliked the way the pilot was separated from the two other crew.

On 4 February 1942, 820 Squadron embarked in HMS *Formidable* on the Clyde and set sail, its destination being Cape Town where it was to join the Eastern Fleet. Leaving Freetown on 7 March, the squadron launched on a dark night to make a practice torpedo attack on *Formidable* at 500ft. There was a descending cloudbase and the Albacores were tightly bunched together. Lithgow's, X9170, was hit by the slipstream of five aircraft ahead of him and flew into the sea

RIGHT: Smartly clad at Sherburn-in-Elmet in July 1950, where he won an all-jet race in an Attacker at an average speed of 570mph. *AEROPLANE*

FAR RIGHT: Mike and Dorrie Lithgow at home with two of their three children. ALAMY

at 140mph. All three crew survived but they only had their Mae Wests as the dinghies had gone down in the Albacore. They realised no-one would know about their plight until all the unit's aircraft had landed. Amazingly, after five hours at night in the South Atlantic *Formidable* came into view, zig-zagging to make herself a difficult U-boat target. As luck would have it, she steered their way. The three of them bellowed for help and, although it's hard to credit, were heard and speedily rescued.

◆

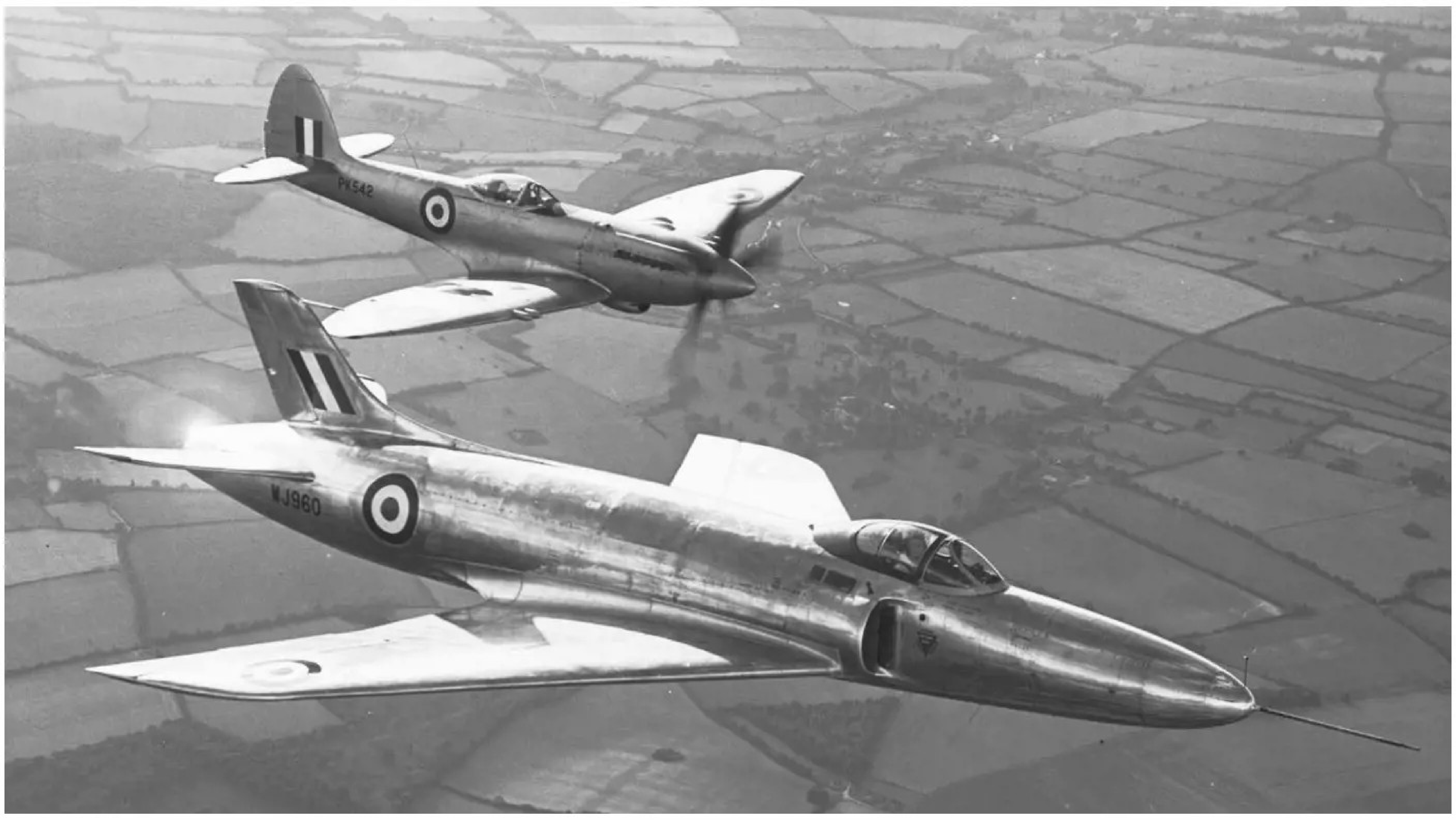
Mike's squadron commander evidently viewed his abilities more highly than his predecessors. No longer rated as just an 'average' pilot, he had now reached the heights of 'above average'. In October 1942 he was appointed to the Aeroplane and Armament Experimental Establishment at Boscombe Down to familiarise himself with the new Fairey Barracuda. He'd been there for just over a month when — on the anniversary of his crash in the South Atlantic — he severely damaged a Barracuda, P9677, when trying to take off from one of Boscombe Down's bumpy runways. This was the beginning of Mike's career as a test pilot. He had the opportunity to familiarise himself with many British types as well as American aircraft sent over for evaluation, such as the Grumman Martlet and Hellcat and the North American Mitchell.

Mid-October 1943 brought assignment to the British Admiralty Delegation to demonstrate the Barracuda, Seafire and Firefly to the US forces. After blacked-out Britain, the States represented quite a contrast. The crated-up aircraft arrived in New York and were flown to the US Navy's test centre at Patuxent River, Maryland. There he persuaded a burly American commander into the Barracuda, who on landing commented, "Well, there's only one thing will supersede this, and that's the aeroplane". Mike also experienced even more American types, among them the Vought Corsair, Curtiss Helldiver, Grumman Avenger, Lockheed P-38 Lightning and Consolidated Catalina.

In the USA Mike was fortunate to meet Gp Capt Sam McKenna, CO of the Empire Test Pilots' School, which enabled him to attend the second ETPS course at Boscombe Down. The voyage home was on a very cramped *Cunard Queen*, converted into a troopship. He joined on 3 March 1944. Lithgow's first flight at the school was with Jimmy Orrell, who later became chief test pilot for Avro at Woodford. They were flying an Airspeed Oxford on 13 March when the port engine stopped on approach to land. Jimmy put the aircraft safely down in a ploughed field short of the runway. The Oxford was towed into the aerodrome, where the offending engine ran perfectly. Jimmy and Mike were jokingly accused by the engineers of having done it deliberately. At the ETPS Mike flew many types that were new to him, including multi-engine machines such as the DH Mosquito, Vickers Wellington and Handley Page Halifax.

After Farnborough the graduates were dispersed to aircraft firms to assist their test pilots while awaiting a further posting. In November Mike had the good fortune to go to Supermarine for a couple of months, joining chief test pilot Jeffrey Quill and up to 10 others coping with the development and production testing of Spitfires. He was then posted back as a naval test pilot to Patuxent River, "of which I had such pleasant memories from a year or so earlier."

By now a lieutenant commander, Lithgow was with the British Air Commission in the USA from 10 February 1945, primarily evaluating whether American aircraft would be suitable for service with the UK forces. At Patuxent River he was permitted to fly any type available. Among those he sampled was the Grumman F8F Bearcat, which he referred to as, "a delightful aircraft… the nearest approach to the Spitfire produced in America". He had just one flight in the hybrid



BELOW: Accompanying Mike and Type 541 WJ960 is Jeffrey Quill in Spitfire F22 PK542. This August 1951 sortie saw the 541 making a dead-stick landing back at Chilbolton after aileron flutter. *AEROPLANE*

Ryan Fireball. Mike's first experience of a pure jet was on 9 June 1945 in a Bell Airacomet, of which there were two at Patuxent River, both in great demand from pilots wanting to try the new method of propulsion. He also flew the T-6 Texan and a C-47, in the latter case transporting spares for a Seafire.

Mike greatly enjoyed his time in the USA, not least because one of the perks afforded to senior British naval officers was to have their 'own' aircraft. He was allocated a Grumman Widgeon five-seater amphibian, remarking that it "flew me and [...] my friends [...] over most of the Eastern Seaboard within easy range" of Patuxent River.

On 4 November 1945 he sailed home on the *Queen Mary*. He already had a job in hand as Jeffrey Quill at Supermarine had offered him a position as test pilot, to which end he was released from the Royal Navy on 22 December. Soon he met Dorrie, and they were married within a matter of weeks.

> *"Jeffrey Quill at Supermarine offered him a position as test pilot"*

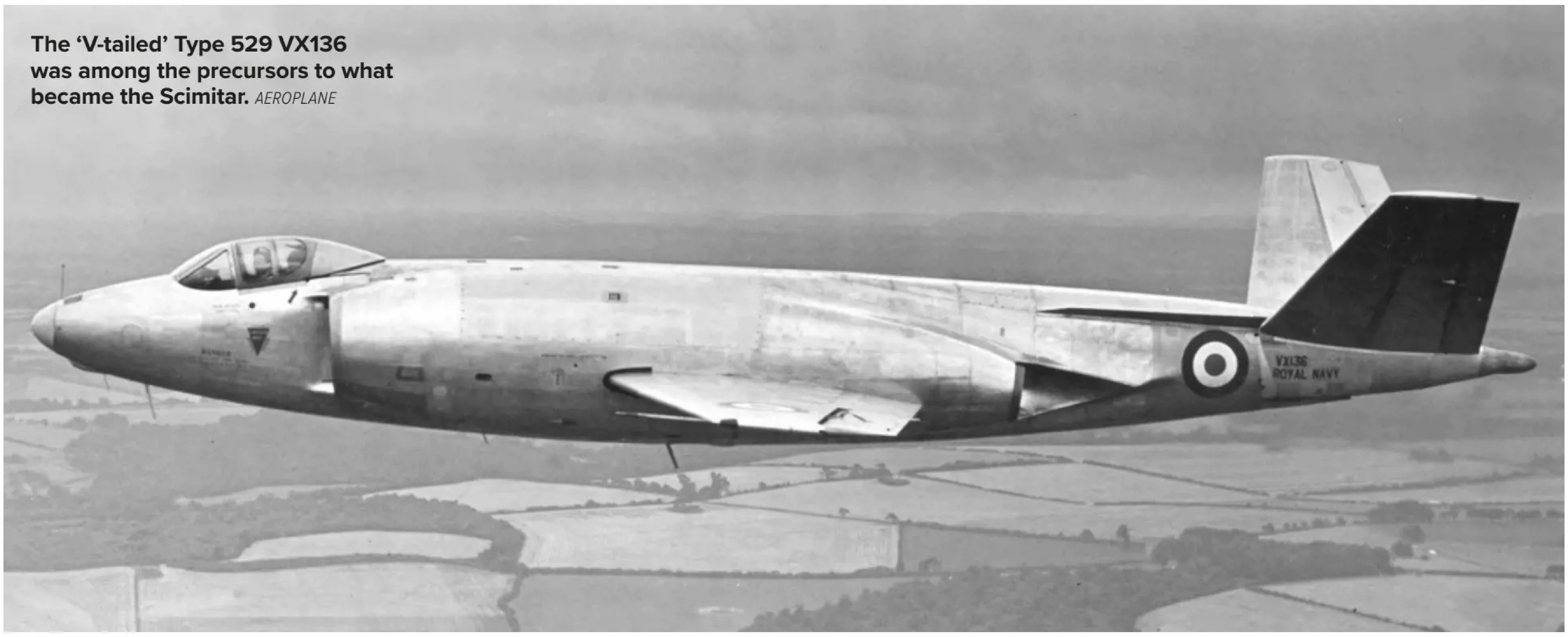
Lithgow joined Supermarine at High Post, Wiltshire, on New Year's Day in 1946. Despite the war being over the production lines were still churning out Spitfire 22s and 24s, soon superseded by Seafire 46s and 47s. Mike was immediately engaged in intensive production test-flying of Spitfires and Seafires, interspersed with some trips in communications aircraft and Sea Otter amphibians.

Testing was moved in 1947 to Chilbolton near Stockbridge, which, unlike High Post, had tarmac runways. The company's design department and experimental works were at Hursley Park, not far from Winchester. Prototypes were constructed there and transported elsewhere for final assembly. For example, having rolled off the Hursley Park line the Attacker prototypes were assembled at High Post and flown from Boscombe Down. There was a factory at Itchen, which was rebuilt after wartime destruction and built amphibians. Production was centralised at South Marston, north-east of Swindon.

On 2 February, Mike had his first flight in Spiteful prototype NN664, a development of the Spitfire fitted with a laminar-flow wing. Despite many modifications through the lengthy trials, it did not prove to be a great advance. During 1946, the order for 650 Spitefuls was cut and cut again. In all only 19 were built. Even so, work continued and RB518 with a specially boosted Griffon achieved 494mph in 1947. According to Mike, RB518's engine spent much of its time at colossal boost and resented it, resulting in, "no less than seven forced landings in as many months. I think I can claim credit for at least three of these, but I certainly had the last word, as on the final one I undershot Chilbolton, which had only recently become our experimental aerodrome, and stove both the main undercarriage legs up through the wings". While being recovered by crane, it was dropped from height and written off.

The navalised version of the Spiteful was the Seafang. It introduced hydraulically folding wings, an arrester hook and a long-stroke undercarriage. Lithgow made his first appearance in the air at the SBAC exhibition, then at Radlett, demonstrating Seafang VB895 on two of the show days. Supermarine tried to sell the Seafang to the navy against its own Seafire 47 but lost the order. Mike writes that he thought the RN made the wrong decision, pointing out how easily he made "twelve consecutive and completely trouble-free landings" of the Seafang on HMS *Illustrious*, even though he had not landed on a carrier in five years.

"Another aeroplane [...] occasionally wheeled out of the hangar for our edification", Lithgow recounted, "was the S24/37... christened 'Dumbo' for obvious reasons".



The 'V-tailed' Type 529 VX136 was among the precursors to what became the Scimitar. *AEROPLANE*

RIGHT: Swift F4 WK198 in the summer of 1953, not long before its record flight. BAE SYSTEMS

In March 1946, Mike had his first chance to get behind the controls of R1815, the surviving example of two of these dumpy Type 322s which had been built as torpedo bomber prototypes during 1943. Their most significant feature was a variable-incidence wing which could be altered by 10°. The type also had a slotted leading edge and full-span flaps, and proved a useful research tool for the Seagull amphibian.

It was Lithgow who made the maiden flight of the Spitfire VIII Trainer, registered under B Conditions as N32, on 9 September 1946 — it was ferried to the Radlett SBAC show the following day. N32 became G-AIDN in January 1947. It was much in demand for demonstrations and Mike wrote amusingly of it, "I have sat dutifully in the back seat while emissaries of [...] countries [...] have performed the most extraordinary manoeuvres... I often think this was my most gallant service to Supermarines. [A] very senior officer from a Latin country [...] proceeded to demonstrate loops with so much 'g' that I was barely conscious most of the time. Finally, sale or no sale, I had had enough and firmly took over, ignoring his vigorous protestations."

The jet age was now upon Supermarine, and Jeffrey Quill completed the initial flight of the Rolls-Royce Nene-powered Attacker prototype, TS409, in July 1946. Lithgow's first opportunity to pilot the type came on 3 March 1947, not long before he took over the role of Supermarine chief test pilot from Quill in mid-year. As such, in June he took into the air the second prototype Attacker, TS413, a fully navalised version with an arrester hook and folding wings.

It was in TS409 that, on 28 February 1948, Mike captured the 100km closed-circuit air speed record, reaching 560.6mph. Determined to improve on this, he tried again two days later and raised the bar to almost 565mph. The RAF showed no interest in the Attacker but the Royal Navy placed an initial order for 60. In October Mike made a trial landing on HMS *Illustrious*, having the previous month displayed TS409 at the Radlett SBAC show. During the year he demonstrated it to both the Brazilian Navy and the French armed forces.

The first production Attacker, WA649, took to the air in Lithgow's hands on 5 April 1950. When Supermarine decided to send an example on a sales tour of the Middle East, Mike in his memoir seemed unimpressed with the idea and wrote, "The chances of selling a large number were, in fact, remote, if only on the grounds of cost". It proved an expensive undertaking as a Vickers Valetta — itself demonstrated as a military transport — accompanied TS409, carrying a servicing team and spares. The tour started in mid-May and continued for six weeks, Mike showing TS409 in Tunis, Cairo, Beirut, Damascus, Tehran, Ankara, Athens and Rome. Despite all those demonstrations and flying 7,000 miles, no sales were made.

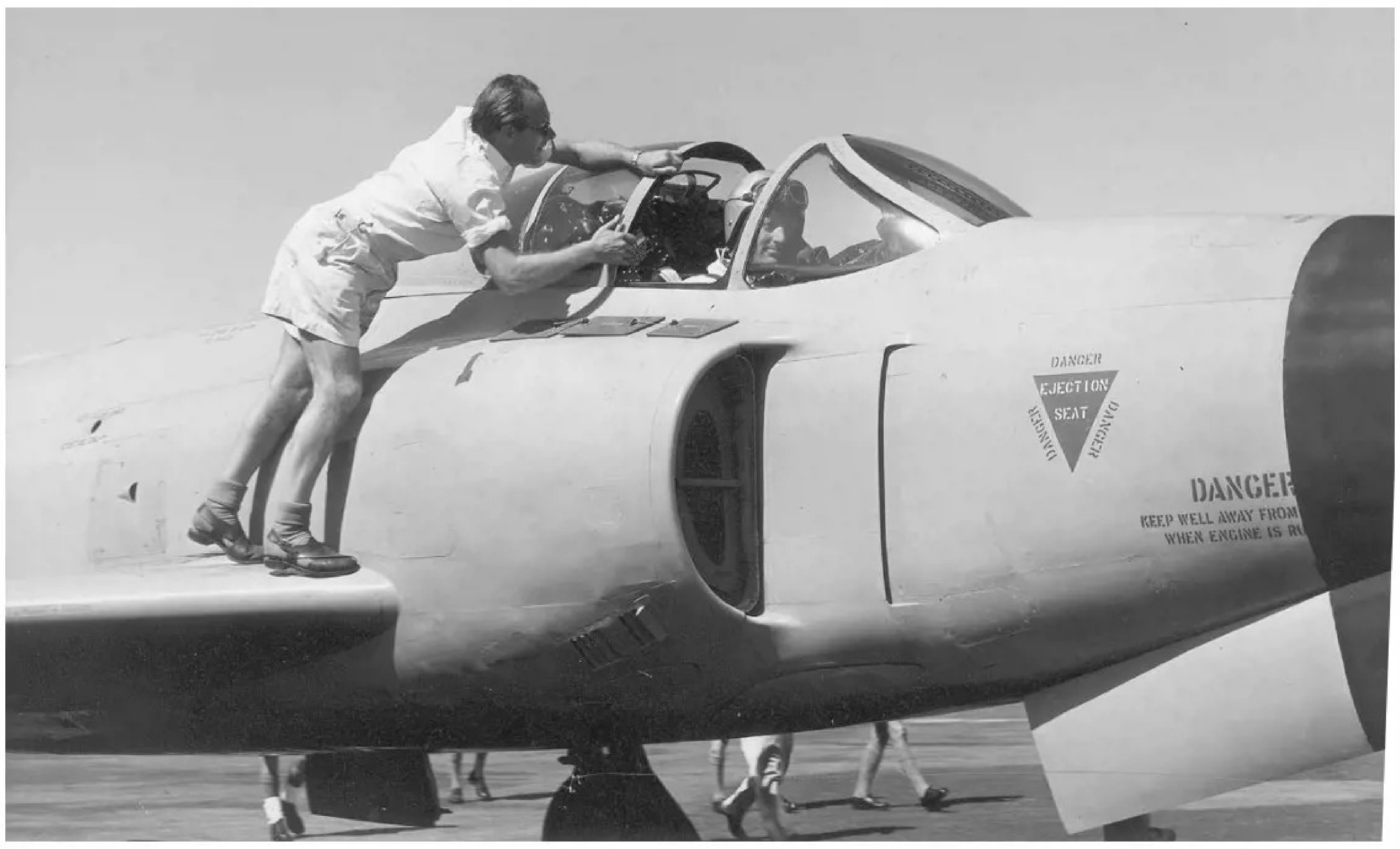
> ***"I had enough and firmly took over, ignoring his protestations"***

The Attacker had already achieved one export success as the Pakistan Air Force had ordered 36 in 1949. Beginning in January 1952, these were ferried to Karachi. Mike took a break from his experimental test-flying to make the delivery flight of the first Pakistani Attacker, serial R4000, leaving South Marston on 9 January 1952 and arriving in Karachi on the 12th.

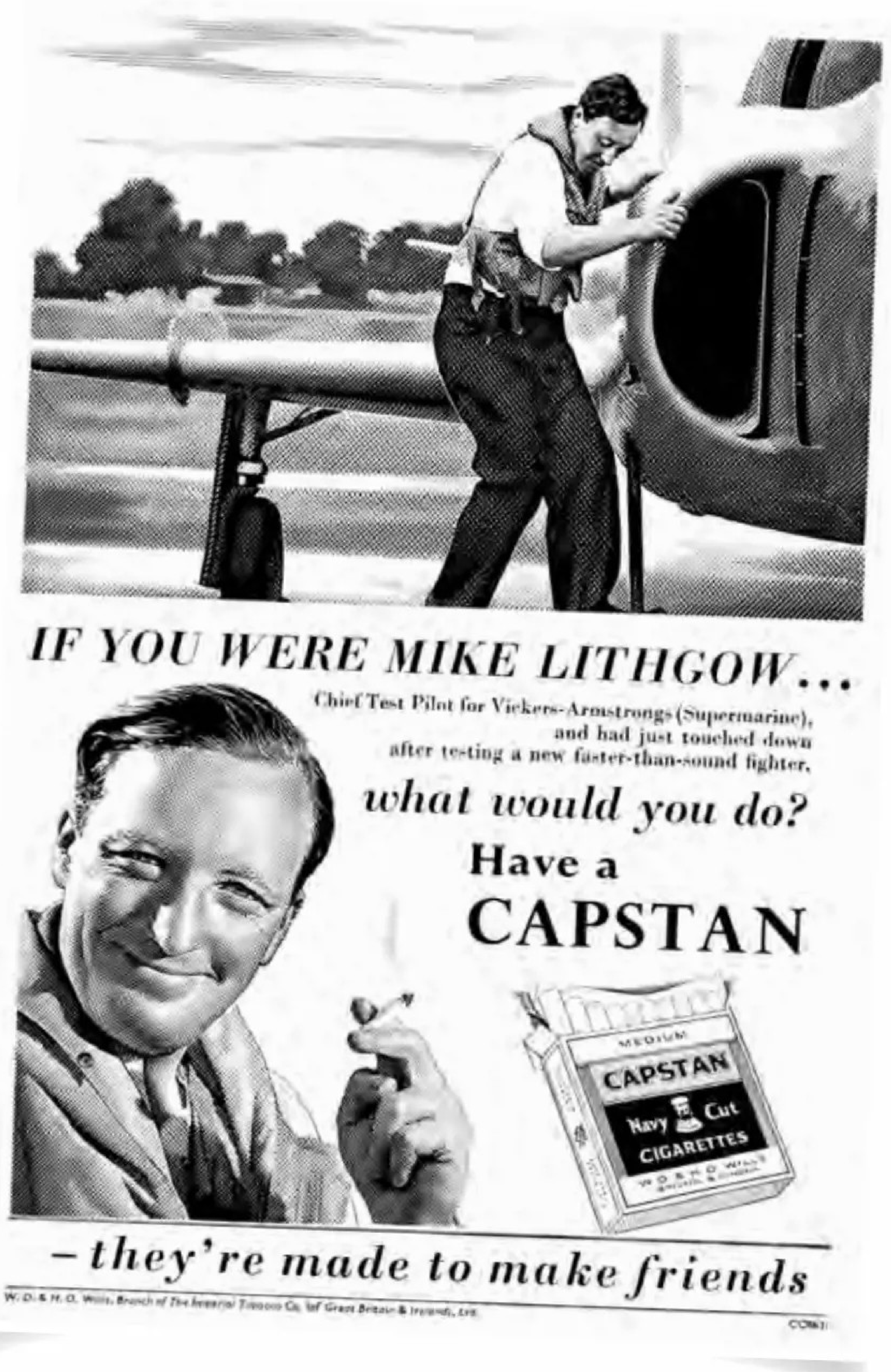
The first maiden flight he made as Supermarine's chief test pilot was of the Seagull ASRI, which proved to be Supermarine's last flying boat. Prototype PA143 was constructed and assembled at Hursley Park, and transported to Itchen for its first flight. Mike began taxiing trials on 21 June 1948. After refinements were made to the floats and spray deflectors added, PA143 got airborne on 14 July from Southampton Water. Lithgow remarked, "It was a somewhat awe-inspiring sight to turn round and to see an enormous six-bladed contra-prop whizzing away not very far from the nape of one's neck". Seagull test-flying dominated the remainder of Mike's year and he demonstrated it at Farnborough for the SBAC show in September. The Griffon-powered aeroplane had an array of high-lift devices and could be flown slowly under a fair measure of control at 50kt.

The second Seagull had detail improvements to its hull and a middle fin to improve stability. In October it carried out satisfactory deck-landing trials on HMS *Illustrious*. But despite Supermarine's efforts the navy was not interested, as helicopters were considered the future for air-sea rescue machines. Both Seagulls were scrapped.

Mike's second maiden flight was of the Supermarine 510, VV106, a swept-wing version of the Nene-powered Attacker but still with a tailwheel undercarriage. This was the first British jet with swept wings and tailplane. In 1948 there was no



TOP LEFT: **With black markings applied to the Swift's nose to ease the job of the record observers in making out the otherwise light blue-painted aeroplane, Lithgow is strapped into WK198 at Idris.** KEY COLLECTION



IF YOU WERE MIKE LITHGOW...

Chief Test Pilot for Vickers-Armstrongs (Supermarine), and had just touched down after testing a new faster-than-sound fighter,

what would you do?

Have a

CAPSTAN

– they're made to make friends

W. D. & H. O. Wills, Branch of The Imperial Tobacco Co. (of Great Britain & Ireland), Ltd.

MEDIUM
CAPSTAN
Navy Cut
CIGARETTES

ABOVE: **The 1954 Capstan cigarettes advert in which Mike appeared.** ALAMY

Christmas-to-New Year shut-down as there is nowadays and Mike took VV106 up from Boscombe Down on 29 December. When the jets came along, Supermarine normally used Boscombe for its maiden flights as it had a 10,500ft runway.

Mike wrote, "It was obvious from the start that the high speed characteristics […] were exceptional, and in a few weeks we were flying at Mach 0.95". Alongside the Attacker prototypes, the Seagull and production testing of Spitfires, he was heavily engaged in the 510 programme over the months that followed. After an engine failure on 16 March 1949 Mike had to make a wheels-up landing at Chilbolton, but the new jet was back in the air after 55 days.

At the Farnborough show of 1949 Mike really made a name for himself, flying the 510 every day and reaching speeds of 670mph in 100ft passes, making it the fastest aircraft at the event. With its swept-back wings and tail, in Lithgow's hands the 510 impressed onlookers far more than the straight-winged DH Venom or Gloster Meteor. To demonstrate the 510's versatility it was fitted with an arrester hook for deck landing trials on HMS *Illustrious*. Mike wrote, "We were uncertain about the take-off of the 510 from the deck, and to be on the safe side provision was made for two RATOG [rocket-assisted take-off gear] units on either side of the fuselage."

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Supermarine was a hive of industry in 1950. Mike made the maiden flight of the third Attacker prototype in January and on 27 March he first flew VV119, the Type 528, externally similar to the 510. Just two months later VV119 was returned to Hursley Park for substantial modifications. These included a tricycle undercarriage with a necessarily longer nose, although the original twin tailwheels were retained. Its Nene engine also received reheat. In this new configuration it became the Type 535 and that September Mike once again wowed the Farnborough crowds with a powerful display.

Lithgow was especially busy in August 1951, making the initial flights of two new types from Boscombe Down. He was airborne in the first Type 541, WJ960 — in essence a 535 with an Avon engine — on the opening day of the month. Only two days later, flying in formation with a Spitfire for a photo-shoot, WJ960 experienced violent aileron flutter. The engine stopped but as he was only 10 miles from Chilbolton, Mike skilfully made another of his dead-stick landings. Late in August he took VX133, the Type 508, on its maiden flight. With twin Avons, a straight wing and a 'V-tail,' it was a development aircraft for a carrier-borne interceptor and low-level nuclear strike aircraft which became the Scimitar. Both VV119, the 535, and VX133 were exhibited at Farnborough.

Unfortunately, the Air Ministry's decision to procure the 541 as the Swift did not prove to be among its better ones. With the outset of the Korean War the RAF had become alarmed at the superiority of the American Sabre and Soviet MiG-15. In November 1950 the RAF ordered 100 Swifts, soon raised to 500. Unfortunately this attempt to rush the type into service dogged it throughout its brief active life. Unlike the Hawker Hunter, which was a fresh design, the Swift lacked fuel capacity, had poor airfield performance and needed a new wing configuration to improve its handling.

LEFT: **WK198 in the course of a high-speed run in Libya.** BAE SYSTEMS

ABOVE: About to land back at the conclusion of the first flight of the Type 525, VX138, from Boscombe Down in April 1954. AEROPLANE

Swift F1 prototype WK965, developed from the 541, flew on 18 July 1952 with a shorter nose, new fin, air intakes and powered ailerons, more closely matching the production version. But the first production F1, WK194, received an unfavourable evaluation from Boscombe Down's pilots. To bolster the Swift's flagging credentials, on 5 July 1953 Mike flew F4 WK198 from Heathrow to the Paris Air Show in just 19 minutes at just 1,000ft, reaching 670mph. To cap that off, he returned the following day at 700mph — a precursor to the events of September, and the world speed record which stands as the aircraft's finest achievement.

While Supermarine had been finishing off Attacker production in 1952, it was running two parallel test programmes, one for the 'super-priority' Swift and another for the Type 508. Mike was flying the 508, VX133, on 5 December 1951 when it began vibrating rapidly and pitched up violently. He blacked out as the aircraft pulled 11g. Thankfully he came round at 11,000ft and landed normally at Chilbolton. After repair VX133 flew again and exhibited the same problem, but the cause was identified as aileron flutter. Fully powered controls overcame this and Mike conducted deck landing trials with VX133 aboard HMS *Eagle* on 28-29 May 1952. He followed that up on 29 August with the first flight of the Type 529, VX136, which was similarly configured to the 508 and which he demonstrated at Farnborough the following month.

The 508 and 529 were development aircraft for the Type 525 which had the same fuselage, but a swept wing and a conventional swept tailplane. On 27 April 1954 Mike took the 525, VX138, on a trouble-free maiden flight from Boscombe Down. For the annual Farnborough showcase VX138 was painted cream overall and flown by Mike. However, there was a serious setback when the 525 crashed on 5 July 1955 after entering a spin, killing navy pilot Lt Cdr T. A. Rickell. This put the programme on hold for six months.

With the rationalisation of the aircraft industry in the mid-1950s and the cancellation of much of the Swift order, Vickers-Armstrongs — which had owned the company since 1928 — carried out a reorganisation. Supermarine ceased to exist and Mike was appointed deputy to Vickers' chief test pilot, Jock Bryce. The test centre at Chilbolton closed in early 1956 and all development flying moved to Vickers' test airfield at Wisley in Surrey. Thus in the winter of 1955-56, in addition to single-seat combat aircraft, Mike was sometimes flying Valiant bombers and Viscount airliners from Wisley.

◆

During 1956 Lithgow made the maiden flights from Boscombe Down of the three Scimitar prototypes. On 19 January 1956 he flew WT854, performing deck landing trials aboard HMS *Ark Royal* on 9 April, but just a week later the nosewheel jammed up and he had to land at Wisley with just the mainwheels down. Thanks to Mike's gentle handling, only the lengthy test nose probe was damaged. The second prototype, WT859, followed in late June and the third, WW134, in October. While flying the latter on 9 July 1958 he had a birdstrike, which shattered the windscreen and damaged an engine, but he landed safely at RAE Bedford.

Mike was in command of the first production Scimitar, XD212, on its maiden flight from the South Marston factory airfield on 11 January 1957. As the maker only had orders from the Royal Navy, XD212 and the second Scimitar, XD213, flew to the Paris Salon at the end of May. Mike performed in '213 on two of the show days but no other deals were forthcoming. He made his final series of demonstrations at the SBAC show that year with Scimitar XD218, having flown every year at the event from 1946.

RIGHT: The Scimitar was the last military aircraft test effort which saw Mike's involvement. AEROPLANE

There were many difficulties during Scimitar work. Damage was done to XD212 on several in-flight refuelling trials in mid-1960, but on each occasion Lithgow landed without further incident. Scimitar work waned during 1962, by which time Mike had increasingly moved from military to civil testing.

He experienced another new type during March 1959, when together with Jock Bryce he piloted the Vanguard prototype, G-AOYW. They flew Vanguard G-APEA to Montreal and back in late June 1959 as a demonstration to Trans-Canada Airlines, which had bought 23. Despite being a conventional design the Vanguard had a lot of problems which had to be overcome, and Lithgow was deeply involved in assessing them. From April-June 1961 he was in Khartoum and Johannesburg captaining CF-TKA on ‘hot and high’ tests with fellow test pilot Dickie Rymer. That October he delivered one of the last Viscounts, G-ASBM, from Hurn to Tokyo for All Nippon Airways. Only a few weeks after the maiden flight of the prototype VC10, G-ARTA, he was introduced to it by his colleague Brian Trubshaw on 19 July 1962. However, he was still mainly engaged in the Vanguard effort, regularly flying the final aircraft, CF-TKW, and only seldom VC10s.

With Mike’s extensive testing experience he was the obvious choice as project pilot on the BAC One-Eleven. It was a replacement for Vickers’ highly successful Viscount and orders for 60 had already been received from airlines around the world, including major US operators, so the importance attached to the programme was hard to underestimate.

On 20 August 1963 there was a feeling of eager anticipation in the air at Bournemouth’s Hurn Airport as people clustered for the first flight of One-Eleven G-ASHG. For the occasion, Jock Bryce was captain and Mike Lithgow was co-pilot. After taxi runs in the afternoon, leaving the dignitaries, the crowds and press waiting, finally G-ASHG lifted off in the early evening. The light was starting to fade by the time it touched down uneventfully. Why did Mike not make the maiden One-Eleven flight? According to Jock Bryce, Mike refused and said, “Not on your life. I’ve never done a first flight in a big aeroplane… you’ll fly it on the day and I’ll come along as your second pilot.”

LEFT:
Gabe ‘Jock’ Bryce (right) captained the first prototype BAC One-Eleven on its maiden flight, with Lithgow as co-pilot.
GETTY

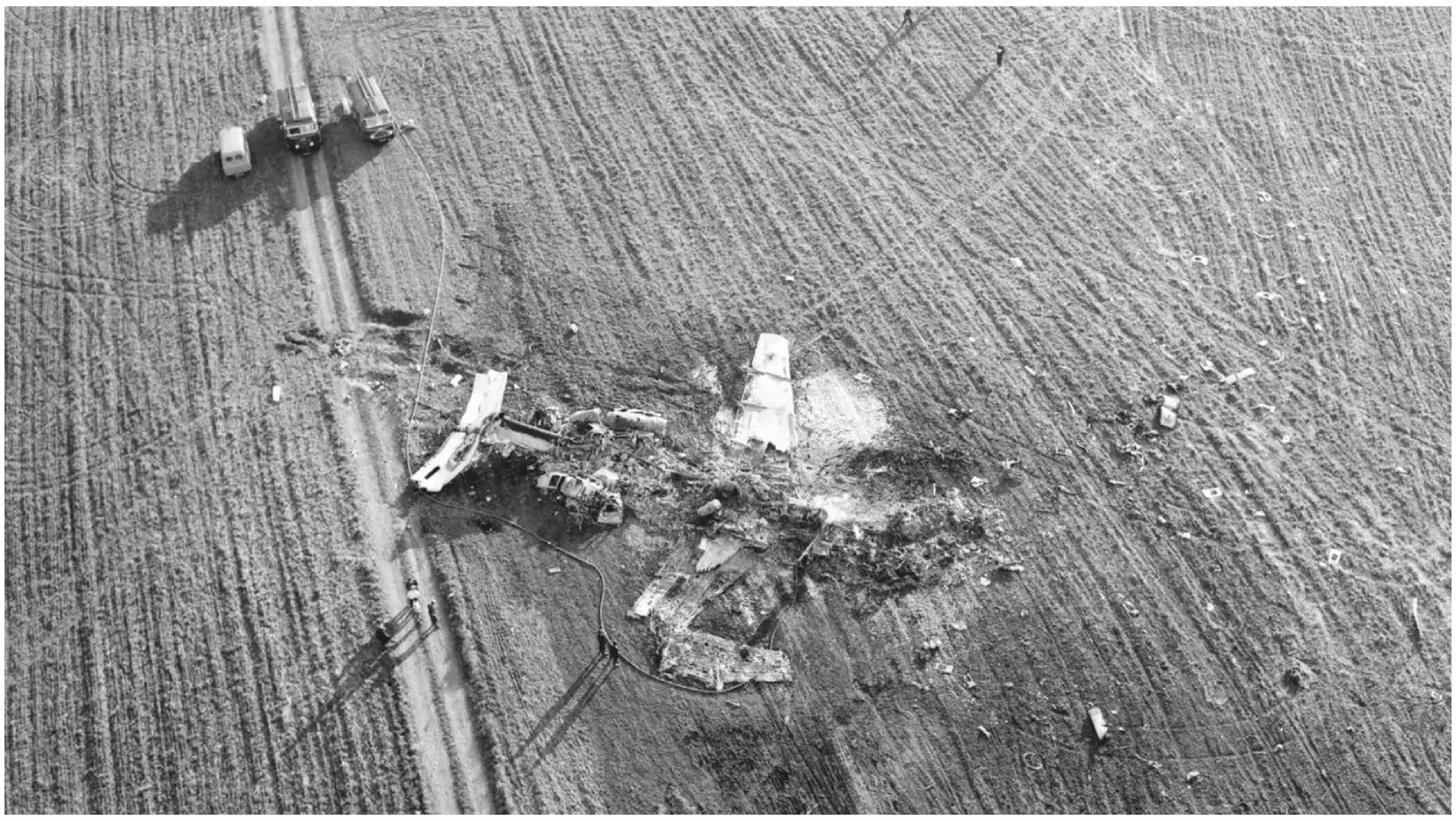
After five flights from Hurn, G-ASHG relocated to Wisley and the test programme began in earnest. Jock and Mike alternated as pilot or co-pilot on almost every sortie. Dickie Rymer made a few of them and accompanied Mike as co-pilot on 22 October, the One-Eleven’s 53rd flight. G-ASHG took off from Wisley at 10.17hrs that fateful morning, with five other crew on board. It was engaged in stalling tests and had successfully executed four stalls before entering a fifth at 15-16,000ft. At the stall, the loss of lift was large and abrupt, causing downward acceleration and a rapid increase in incidence, the aircraft’s angle of attack to the airflow.

◆

As the One-Eleven descended at 10,000ft per minute the pilots maintained a massive 100lb push force on the elevators, but to no avail. Lithgow tried banking the aircraft into a sideslip and increased power, but G-ASHG was in a stable stall from which recovery was impossible. At 10.40 it crashed and exploded at Cratt Hill near Chicklade in Wiltshire, killing all seven crew.

It wasn’t long before the news broke at Wisley. Brian Trubshaw immediately set out to inform Dorrie Lithgow of the awful events. Tragically, after all the dangers he had endured in the war and testing high-performance jets, he died evaluating a passenger airliner at the age of 43. He had flown 5,385 hours on more than 90 types. It again underlined what a dangerous occupation test-flying could be in the period, no matter what sort of aeroplane was involved.

On 19 June 1966, three stained glass windows were dedicated in the chapel of Cheltenham College. The inscription reads, “To the Glory of God and in memory of Michael John Lithgow, Cheltondale, 1934-38, who died on 22 October, 1963 testing a new aircraft. These windows have been erected by friends.”



BELOW:
The dreadful scene at the One-Eleven crash site near Chicklade on 22 October 1963.
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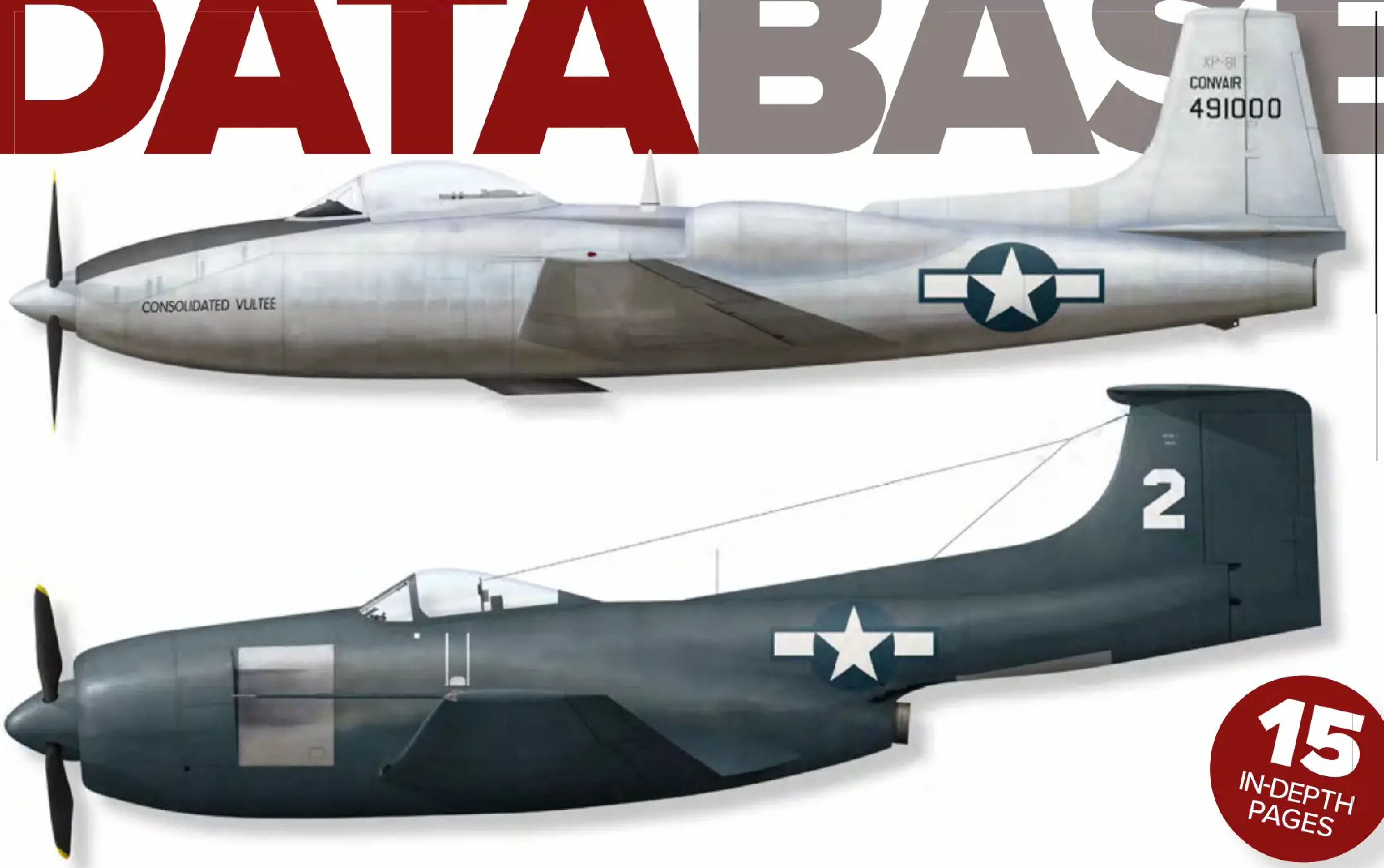
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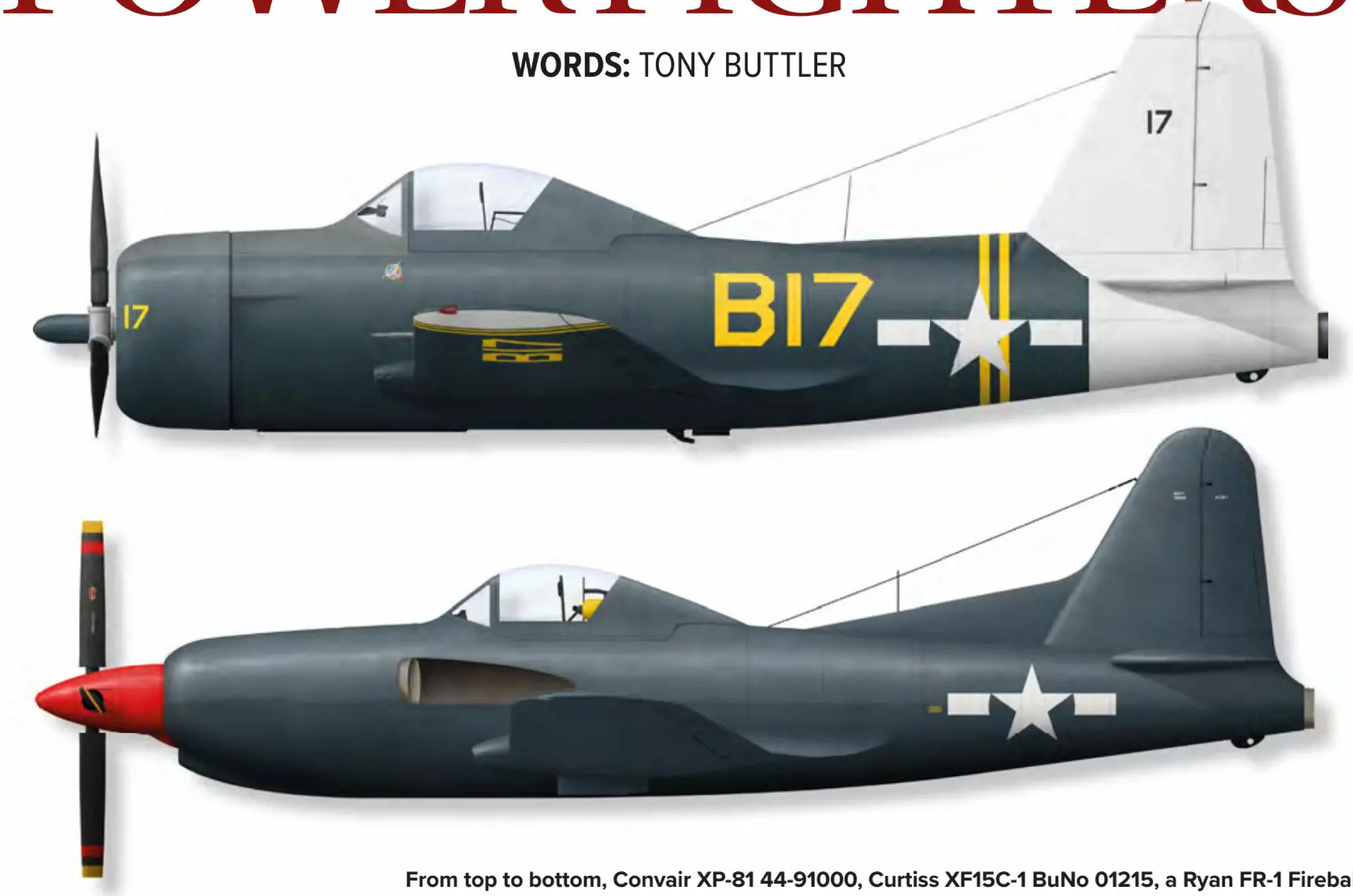
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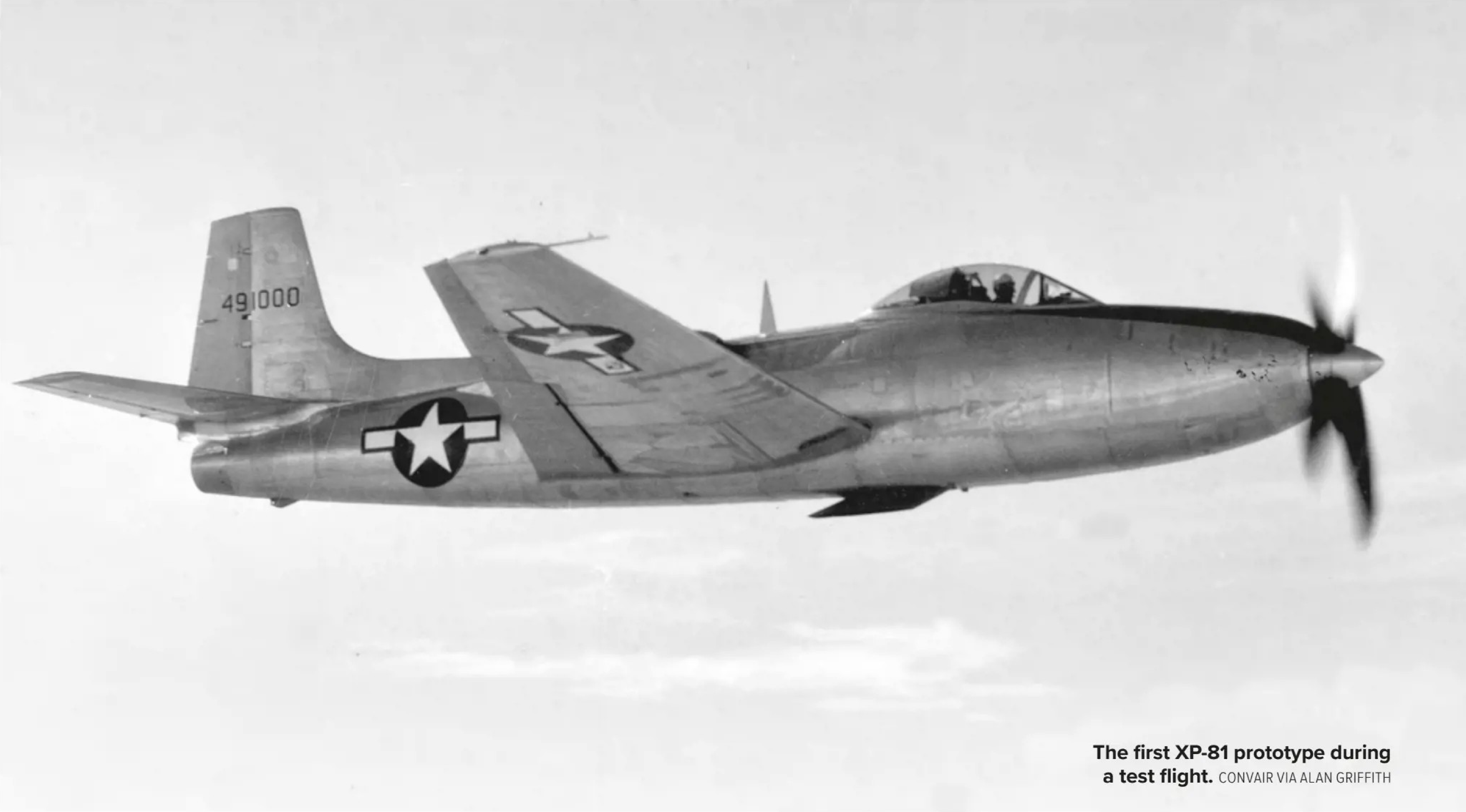
From top to bottom, Convair XP-81 44-91000, Curtiss XF15C-1 BuNo 01215, a Ryan FR-1 Fireball of US Navy fighter squadron VF-41 and Ryan XF2R-1 Dark Shark BuNo 39661. CHRIS SANDHAM-BAILEY

CONVAIR XP-81

A putative long-range escort fighter for the air force



The first XP-81 prototype during a test flight. CONVAIR VIA ALAN GRIFFITH

The US Army Air Forces' losses of heavy bombers during daylight operations over Germany showed the need for a long-range escort fighter, the role being filled by the North American P-51 Mustang. But this experience also influenced plans in the Pacific to bomb Japan with the Boeing B-29, and Convair's XP-81 was designed for this very long-range escort role, though the only such type ordered into production would be North American's P-82 Twin Mustang.

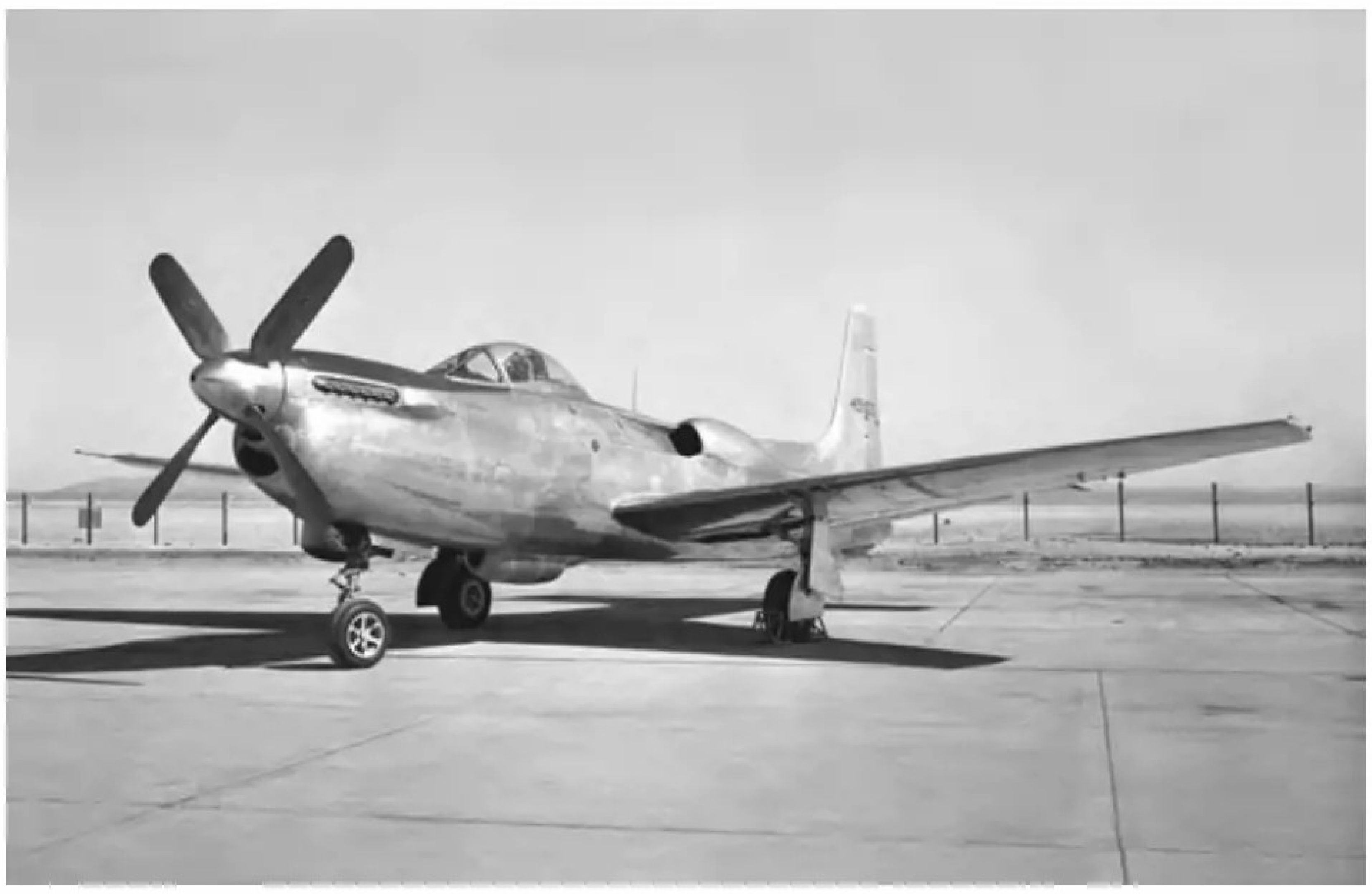
A mid-1943 specification outlined a single-seat, twin-engine, long-range escort fighter having an operating radius of 1,250 miles (2,011km), a maximum speed of 500mph (805km/h) and a combat ceiling of 37,500ft (11,430m). Convair responded with its Model 102 proposal. Chief development engineer Charles 'Jack' Irvine and assistant development engineer — and test pilot — Frank Davis selected a compound powerplant, with a turboprop for cruising across the Pacific plus a supplementary jet for additional power on take-off, for high-speed flight and combat. Such mixed-power configurations were an interim measure until development of the pure jet reached the stage of having sufficient power to give good performance at all altitudes. The chosen engines were a TG100 (XT31) turboprop and I-40 (XJ33) turbojet, both designed by General Electric.

Two XP-81 prototypes, serials 44-91000 and 44-91001, and a static test airframe were ordered on 18 January 1944 under project number MX-480. Initially the AAF looked upon these purely as experimental machines, but a little later an order was placed for 13 YP-81 development aircraft. However, Allied success in the Pacific meant the latter became unnecessary and they were cancelled in August 1945.

Flight-testing

In September 1944 it became clear the TG100 would not be ready in time to power the first prototype, so a 1,450hp Packard V-1650-7 Merlin piston unit was fitted temporarily as a stop-gap measure. The nose of 44-91000 was suitably modified and the maiden flight followed on 7 February 1945 with Frank Davis in the cockpit. The XP-81's performance with the Merlin was far below than the estimated figures for the TG100 due to the extra weight, lower horsepower, the aerodynamic penalty of this improvised installation and the estimated reduction in power at sea level. However, there were no major problems during the Merlin trials and the majority of flight time was spent improving the I-40 tail-pipe installation. In general, the XP-81's handling characteristics were excellent. All control forces were very light and remained so up to the highest speeds studied so far, Mach 0.74.

The Merlin produced a severe tendency to swing to the left on take-off due to torque, but tunnel testing indicated this would improve with the TG100. A further solution saw a vane being fitted in the I-40 and adjusted to produce a right-turning tendency just equal to the left-turning tendency produced by the propeller. Both lateral and longitudinal stability and control were satisfactory, but directional stability needed



44-91000 was in the short term fitted with a Packard Merlin piston engine to enable early flight-testing to proceed despite the late delivery of the TG100 turboprop. CONVAIR VIA DENNIS JENKINS improvement. This resulted in a 15in (38.1cm) span-wise addition incorporated at the top of the fin and rudder, plus an additional short ventral fin, all of which brought directional stability to a satisfactory level. The second prototype had this addition from the start, plus an extended ventral fin.

With both Merlin and I-40 working together at 18,330lb (8,314kg) weight, the maximum rate of climb was 8,600ft (2,621m) per minute at sea level, and the maximum speeds 538mph (866km/h) at sea level and 552mph (888km/h) at 10,000ft (3,048m). A three-month programme embraced 46 flights before, on 18 May 1945, 44-91000 was returned to Convair at Downey for the TG100 to be installed. Further modifications included having the horizontal tail moved 15in (38.1cm) further back, the fin and rudder reduced in height by 10in (25.4cm), and a 19in (48.3cm)-long exhaust nozzle added to the I-40 jet.

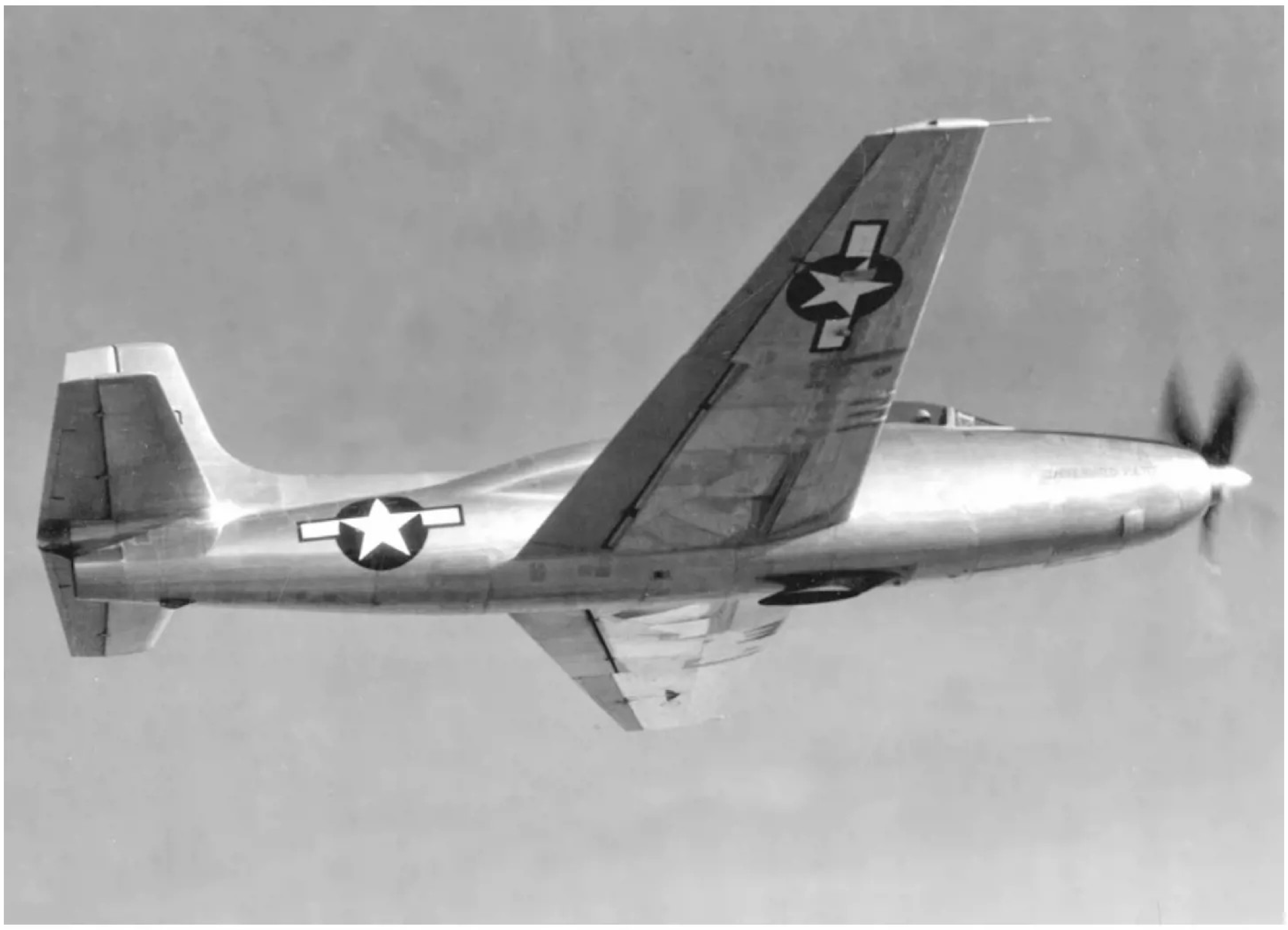
The first flight with the TG100 was made at Muroc on 21 December 1945 and airborne testing of what was the first American gas turbine engine to drive a propeller lasted until 19 December 1946. In all, 47 flights were completed and there were numerous problems. For example, it took the TG100 about two to three seconds to move from 75 to 100 per cent rpm, but the propeller would require up to 20 seconds to alter its pitch to enable full power to be reached. And when the throttle was closed during high-speed taxi runs, a powerful braking effect from the propeller was experienced which occurred quite suddenly around two seconds after the throttle had been closed, when the propeller had returned to flat pitch. So, the pilot experienced at least a 10-second lag when he wished to go forward and then a two-second lag when he needed to stop.

The maiden turboprop flight, again with Frank Davis in the cockpit, lasted just five minutes. The trouble on this occasion was that quite a heavy propeller vibration was experienced as soon as the XP-81 left the ground and continued throughout the sortie. It persisted on flight two, becoming worse at higher speeds and power settings — the engine essentially had no shock mounting.

The engine friction was so low that, when the XP-81 was standing on the ground, the propeller could be kept in rotation by finger pressure. This was a worry since it was considered impossible to find a feathered-pitch setting which in the air would result in a motionless propeller. In fact, a position was found very quickly and the feathered propeller would remain stationary without any auxiliary braking from the stall speed right up to 330mph (531km/h) indicated. In both feathering and unfeathering the change in rpm was far slower than on a piston powerplant, and considerable levels of power were delivered by or had to be absorbed by the engine. Thus, there were longer and more severe effects on the XP-81's handling characteristics than would have been the case with a reciprocating unit.

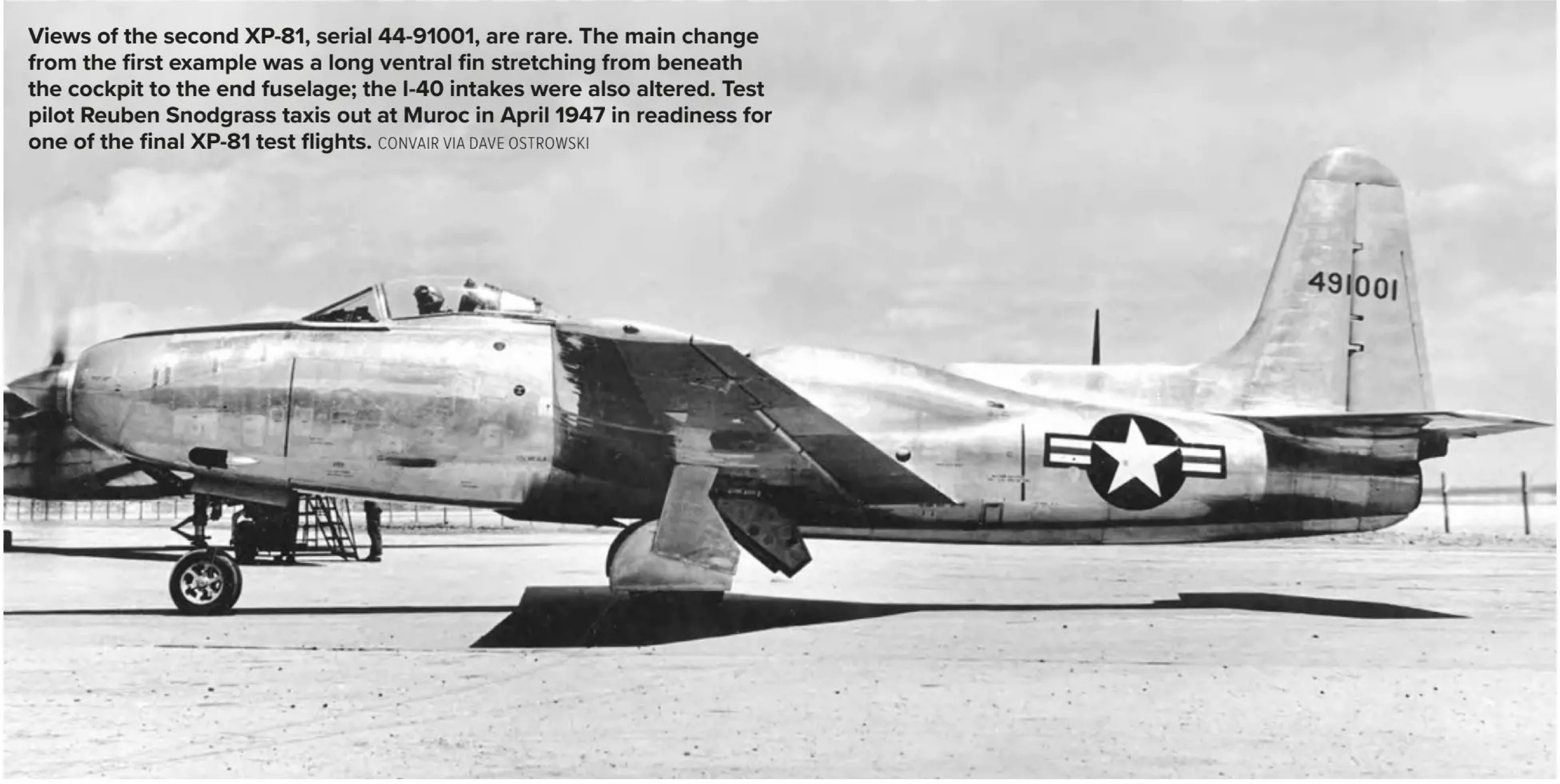
Despite a change of propeller the vibration was still present, and at high speeds this brought serious difficulties. At 410mph (660km/h) indicated at 12,100ft (3,688m), large-scale hunting occurred suddenly and without warning, though detail modifications would reduce it to a safe degree for all level

> ***"At high speeds the vibration brought serious difficulties"***



The TG100 engine's exhaust protruded beneath the centre fuselage of the XP-81. CONVAIR VIA ALAN GRIFFITH

Five of the XP-81 flights between numbers 51 to 60 were used for photography and for demonstration and publicity purposes. This is 44-91000 over the Mojave Desert. CONVAIR VIA GERALD H. BALZER



Views of the second XP-81, serial 44-91001, are rare. The main change from the first example was a long ventral fin stretching from beneath the cockpit to the end fuselage; the I-40 intakes were also altered. Test pilot Reuben Snodgrass taxis out at Muroc in April 1947 in readiness for one of the final XP-81 test flights. CONVAIR VIA DAVE OSTROWSKI

flight speeds. At this time there was no propeller available which had been designed specifically for gas turbines, and using propellers and governors produced specifically for piston engines had in several respects proved unsatisfactory. Also, during the flight trials neither the turboprop nor the jet would produce anything like the predicted levels of power to enable the XP-81 to achieve the estimated performance figures. Instead of the expected 2,300hp the TG100's maximum rating was 1,650hp, resulting in performance little better than with the Merlin installed, and rather than 4,000lb the I-40 gave just 3,750lb of thrust.

In the air the XP-81 itself performed well, with fine handling, light and well-balanced controls and a good rate of climb, but the test programme would be curtailed; for example, the diving trials were never completed. The second XP-81, 44-91001, made its initial flight in February 1947 but there are no detailed flight test records for this aircraft. Apart from the modified fin, it introduced NACA (National Advisory Committee for Aeronautics)-style air intakes instead of straight troughs forward of the I-40's shoulder-mounted intakes. The first XP-81 completed 94 flights in total with the Merlin and TG100 engines, and its flying career ended in January 1947. Together the two aircraft made 69 flights with the TG100 installed, the last of all taking place on 9 May 1947. The AAF concluded the weight of the XP-81 was too high for it ever to become an effective escort fighter.

On 29 April 1949 the two XP-81s were cleared for salvage and subsequently moved to an Edwards Air Force Base bombing range to serve as targets, where they remained until August 1994. Today both bomb-damaged airframe shells are in storage with the National Museum of the US Air Force at Wright-Patterson AFB.

Technical details

The XP-81 was a single-seat, all-metal fighter prototype with a tapered straight cantilever wing and a retractable tricycle undercarriage. The very smooth laminar-flow aerofoil was made possible by using heavy aluminium alloy skin and flush riveting. Aluminium alloy was also used extensively in the semi-monocoque forward fuselage, while the rear fuselage was built in stainless steel. The cockpit was pressurised and an ejection seat fitted.

The nose-mounted TG100 was fed with air entering through an annular nose scoop. It drove a four-blade 12.4ft (3.77m)-diameter propeller and additional thrust came from an exhaust jet directed rearwards just under the pilot; the great majority of the TG100's power came via its propeller, the jet exhaust providing only about 600lb of thrust. The I-40 was positioned behind the pilot with intakes on the upper fuselage shoulder, to the rear of the cockpit, and the exhaust coming through a tail pipe located beneath the rudder.

All the fuel, 811 US gallons (3,070 litres), was housed in the fuselage and there was provision for carrying 350 US gallons (1,325 litres) in underwing drop tanks. Groups of three guns were to be mounted in the wings — they were never fitted — and outboard of these a hardpoint under each wing could take, besides the tanks, depth charges, rockets or various bombs up to 1,600lb (1,452kg) in weight. Further stub pylons along the wings could carry 5in (12.7cm) rockets.

DATAFILE SPECIFICATIONS: CONVAIR XP-81

POWERPLANTS

One General Electric XT31-GE-1 (TG100) turboprop, 2,300shp and one Allison J33-GE-5 turbojet, 4,000lb thrust

DIMENSIONS

Length:	44ft 8in (13.62m)
Span:	50ft 6in (15.39m)
Wing area:	425 sq ft (39.525 sq m)

PERFORMANCE

Maximum speed with TG100:	546mph (879km/h, Mach 0.745) on flight 90, 4 September 1946
Service ceiling:	49,000ft (14,935m)
Range:	2,500 miles (4,023km)

WEIGHTS

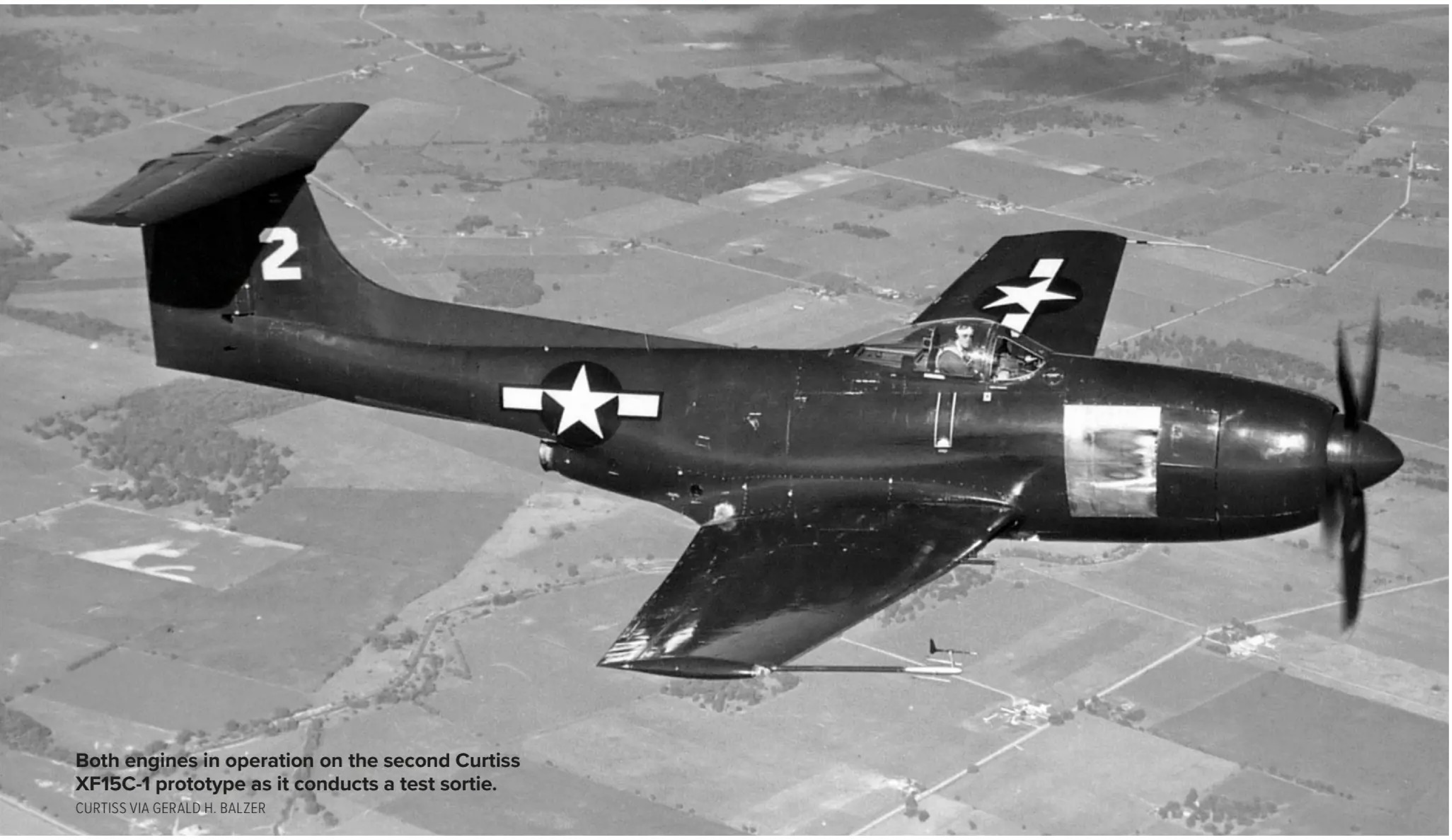
Gross:	19,500lb (8,845kg)
Maximum take-off:	24,650lb (11,181kg)

ARMAMENT

Six 0.50in (12.7mm) machine guns or six 20mm cannon, two 1,600lb (1,452kg) bombs, 14 5in (12.7cm) rockets

CURTISS XF15C-1

Curtiss's first jet was a design soon out of time

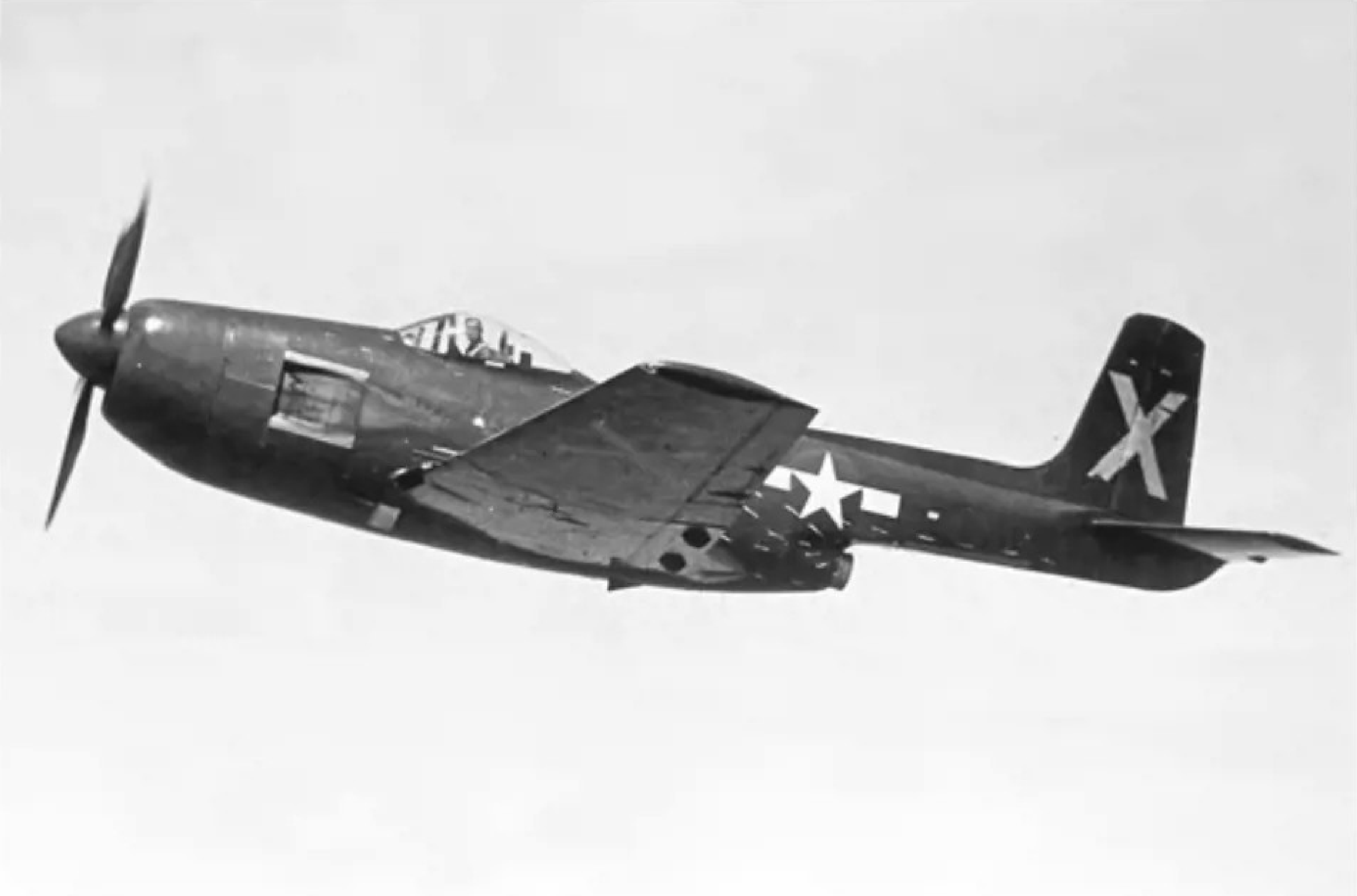


Both engines in operation on the second Curtiss XF15C-1 prototype as it conducts a test sortie.
CURTISS VIA GERALD H. BALZER

The XF15C-1 was the last new fighter type produced for the US Navy by Curtiss and was designed to operate from large combat carriers only, not smaller escort carriers. The adoption of pure turbojet power for carrier operations presented a problem for the navy because the first-generation engines did not provide sufficient thrust to ensure an aircraft could get off the deck safely, even using a catapult. Combining the jet with a traditional reciprocating engine was, in the short term, seen as a solution because there would now be enough power to take off. In addition, the early jets consumed fuel very quickly, so shutting the jet down and using the piston alone would ensure the fighter could cruise over long distances; then, when bursts of high speed were required, say for combat, the jet would provide the necessary extra power.

Curtiss-Wright's first proposals for such a type, dated 1 February 1944, showed an all-purpose medium-range fighter with a radius of action comparable to that of the Vought F4U Corsair and Grumman F6F Hellcat, and with extremely high performance. Heavily armed with four or six lightweight 20mm T-31 cannon, it had a conventional Pratt & Whitney R-2800-34W single-stage piston engine as its main powerplant with an additional British de Havilland/Halford H-1 auxiliary jet unit arranged in tandem; the jet would be built in the US under licence by Allis-Chalmers as the J36. The predicted performance included a speed of about 485mph (780km/h) at 25,000ft (7,620m) with a sea-level rate of climb in excess of 4,890ft (1,490m) per minute. Project engineer at Curtiss was Fred Steele.

Three XF15C-1 prototypes and one static test article were ordered in April 1944 with Bureau of Aeronautics serial numbers (BuNos) 01213 to 01215. Some publications say the aircraft was named the 'Stingeree.'

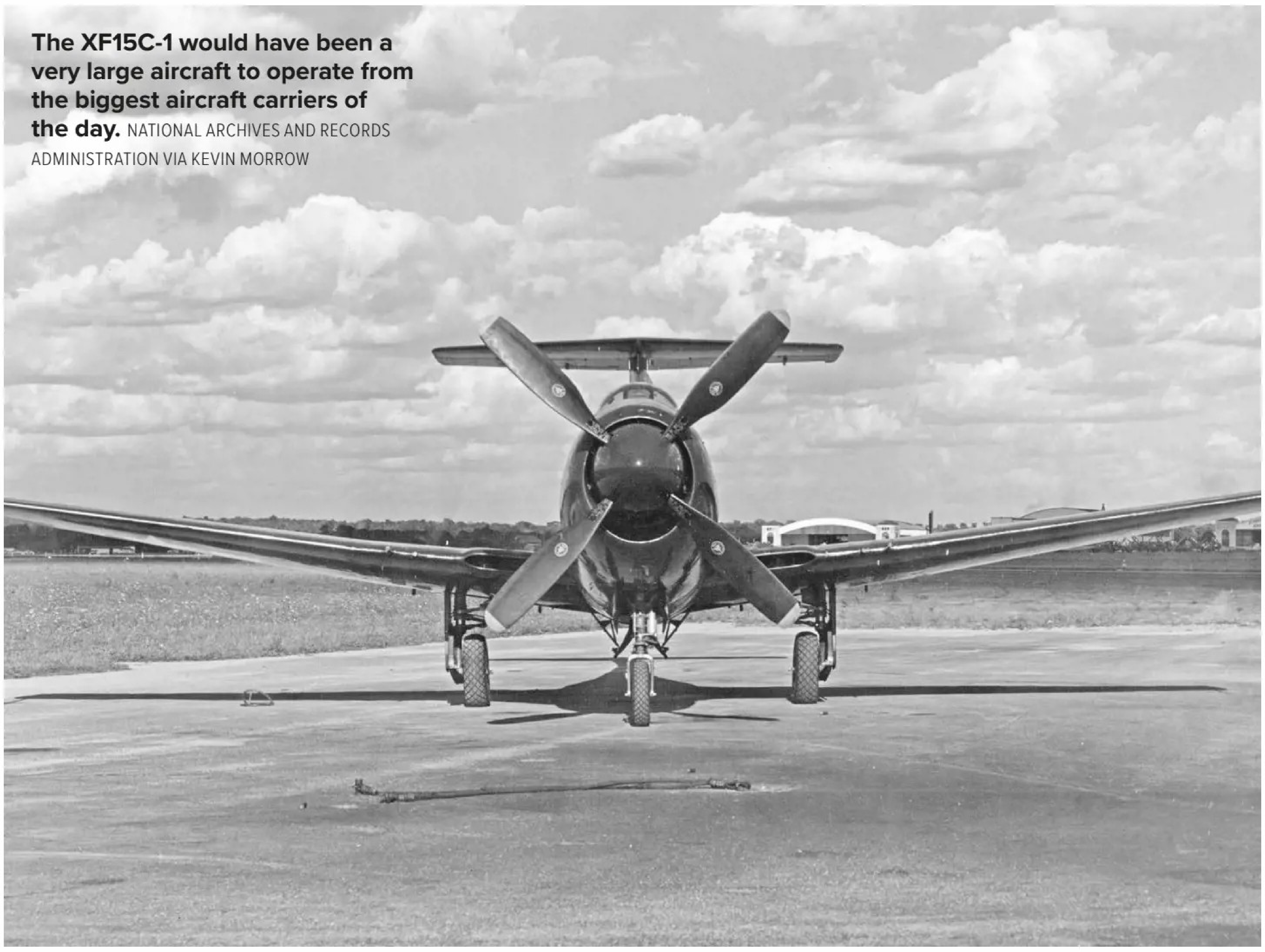


The very short jet pipe for the Halford H-1 engine is apparent on the first XF15C-1. No large serial identity numbers appear to have been carried by any of the three prototypes, at least until the third example reached the NATC at Patuxent River. CURTISS VIA TOMMY THOMASON

Flight-testing

Curtiss had no prior experience with jet engines, so a Grumman TBF Avenger attack aircraft was acquired to serve as a testbed. Ground tests with the H-1 installed in this machine took place during November 1944, with flight trials beginning the following month. On 27 February 1945 it was possible to complete the initial taxi runs, plus some short hops, in the first XF15C-1 prototype, BuNo 01213. The next day Curtiss test pilot Lloyd Child made the maiden flight, but so far only the piston engine had been used.

On 3 May 1945 the first prototype began flying with an experimental H-1 jet installed. To start with there were no major problems, although the aileron rudder forces were somewhat heavy at low speeds and then light at 350mph (563km/h) indicated. Tragically, on 8 May 1945 BuNo 01213 crashed at low altitude after suffering fuel starvation, caused by a faulty valve, while on the approach to land at Buffalo, New York. The pilot, Charles Cox, was killed.



The XF15C-1 would have been a very large aircraft to operate from the biggest aircraft carriers of the day. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION VIA KEVIN MORROW

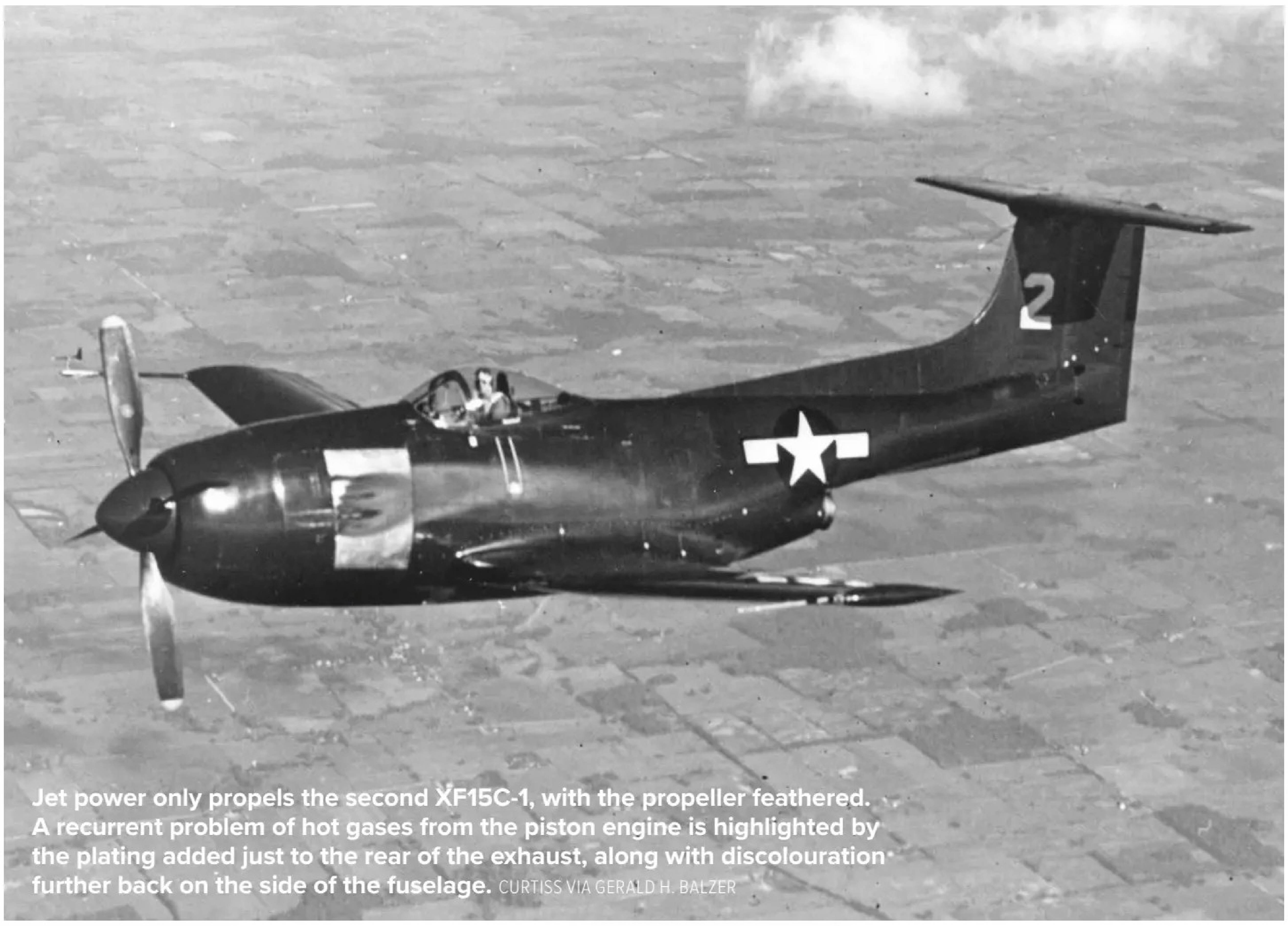
That June Curtiss proposed incorporating a 'T-tail' on the second and third airframes, moving the horizontal surface up from its original low position to the top of the fin, thereby taking it well above the jet exhaust. This new arrangement appeared to offer improvements for the aircraft's aerodynamics during the approach, plus improved stability during high-speed flight. Other alterations included a larger dorsal fin.

The second prototype, BuNo 01214, took to the air on 9 July 1945, again with Child as pilot and now with an Allis-Chalmers-produced J36 installed; both airframes two and three also introduced catapult fittings and tail arrester hooks for carrier operations. However, early service testing by the Naval Air Test Center (NATC) at Patuxent River during October-December 1945 revealed problems with instability when flying at low speeds for landing. In fact the stability characteristics were so poor that the XF15C-1s had to be returned to Curtiss for modification, this being the point when the 'T-tails' were fitted and the vertical tail surfaces enlarged. The third prototype was also test-flown by the Army Air Forces.

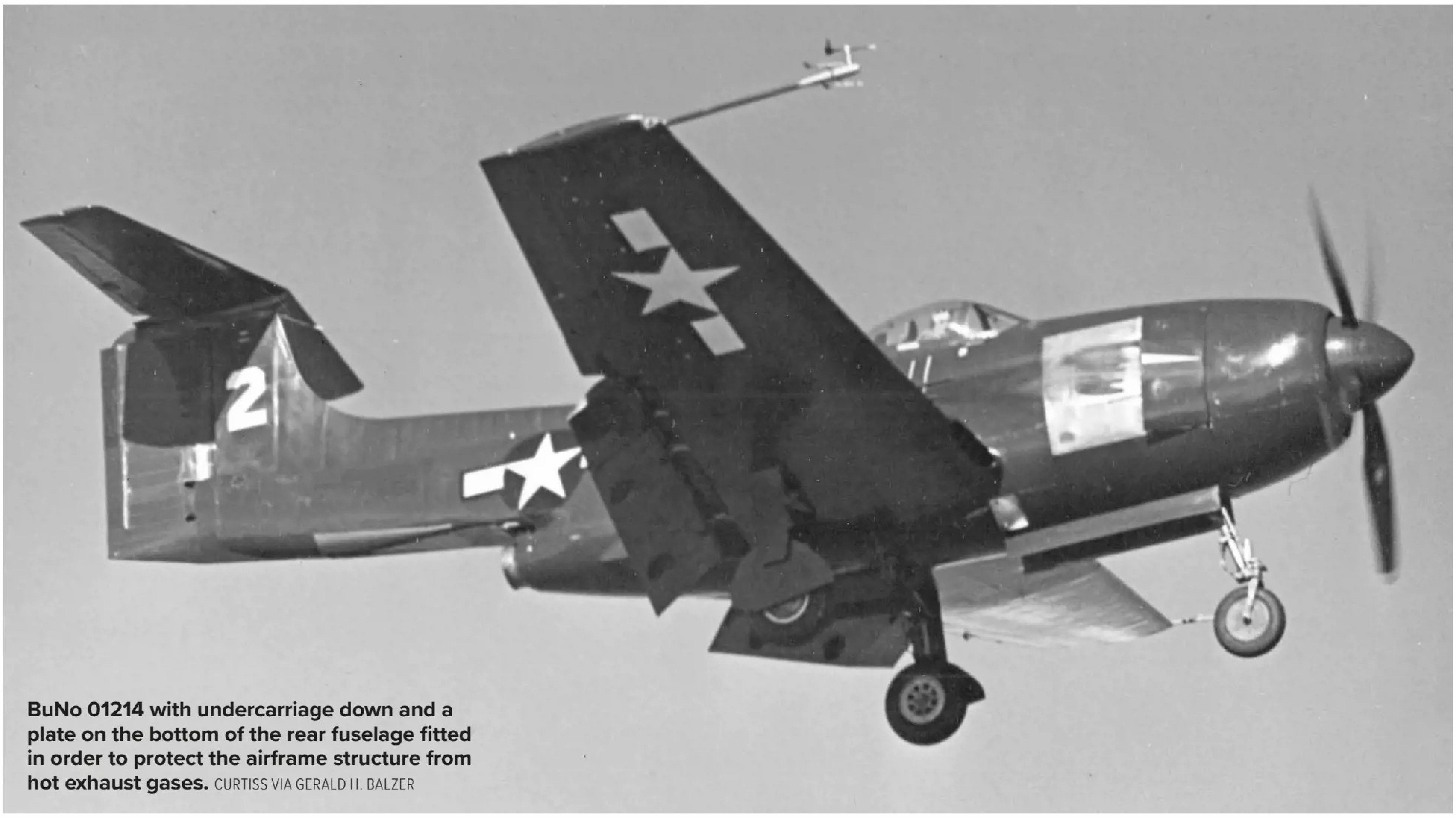
> *“The aircraft had to be returned to Curtiss”*

Test flights were conducted in short batches and covered low Mach numbers only, for BuNo 01214 at times between 14 January and 12 September 1946 (21 flights in all) and then for 01215 between 13 March and 18 September (33 flights). Various aileron and rudder configurations and centres of gravity were tested, and with the 'T-tail' the take-off weights for these flights were 16,270lb (7,380kg) for 01214 and 16,917lb (7,698kg) for 01215. Due to problems with engine cooling at military power in high blower at altitude, the flight cooling tests were halted before any data had been acquired for climbs to service ceiling. Longitudinal stability, stick fixed, was positive for all configurations tested at low speeds in the 100-150mph (161-241km/h) range. Lateral stability was positive, stick fixed, for all conditions, and then neutral, stick free, in the carrier approach condition; the directional stability was positive, control both fixed and free for all configurations. Aileron control and rudder pedal forces were slightly high at large surface deflections only, but the control effectiveness was adequate. No formal performance tests had been conducted with the 'T-tail' and so no data was acquired for other performance parameters.

Stall tests were conducted with 01214 and 01215, the former equipped with conventional single-slotted flaps and the latter with double-slotted flaps. Unfortunately, no clearly defined stall could be accomplished



Jet power only propels the second XF15C-1, with the propeller feathered. A recurrent problem of hot gases from the piston engine is highlighted by the plating added just to the rear of the exhaust, along with discolouration further back on the side of the fuselage. CURTISS VIA GERALD H. BALZER



BuNo 01214 with undercarriage down and a plate on the bottom of the rear fuselage fitted in order to protect the airframe structure from hot exhaust gases. CURTISS VIA GERALD H. BALZER

with either aircraft in any configuration due to severe buffeting which occurred at speeds somewhat above the minimum obtainable, and which made the aircraft very difficult to control. There appeared to be no appreciable difference with the double-slotted flap, but a proper evaluation of this could not be undertaken until the buffet problem was alleviated. That said, the XF15C-1 had failed to meet its guaranteed stall requirements.

Between 19 September and 8 October 1946, BuNo 01214 made six more flights and 01215 a further 10 to obtain longitudinal stability data, information on lateral control characteristics, and to determine the critical altitude for normal rated power. Again longitudinal stability was positive through the complete speed range, stick fixed, in both power approach and landing configurations, and the lateral stability, stick fixed, with the basic aileron configuration, was positive through the yaw and speed investigated for both aircraft configurations. In an attempt to improve the stall characteristics and establish a more clearly defined stall, the volume of the wing-root fillets was increased. The pilot reported no improvement, so the next step was to remove the aft portion of the wing fillet and jet engine fairing completely.

The navy terminated its XF15C contract on 10 October 1946. Very soon new jet engines offering greater thrust meant take-offs from carriers could be accomplished without the need for the complexity of a composite powerplant. Following contractor flight-testing through the autumn of 1946 the two surviving prototypes went to the NATC at Patuxent River for evaluation, before being disposed of during 1947. Having made its last flight in May 1947, BuNo 01215, the sole surviving XF15C-1, is currently on display at the Hickory Aviation Museum in North Carolina.

Technical details

The XF15C-1 was a single-seat, all-metal fighter with a low-position, laminar-flow cantilever wing and tricycle landing gear. The wing could be folded for stowage aboard carriers, the piston unit drove a 13ft 1in (3.99m)-diameter four-blade constant-speed propeller, and the jet engine was positioned low in the rear fuselage with wing-root intakes and a short tail-pipe. The shallow rear fuselage was then extended as a boom for the tail and both power units used aviation gasoline fuel; the internal fuel capacity was 376 US gallons (1,423 litres) and the maximum with external tanks 526 US gallons (1,991 litres). On abandonment of the original low-set horizontal tail position, a new horizontal surface was mounted on top of the vertical fin as a ‘T-tail’. There was a bubble canopy and four 20mm guns were to be installed in the wings outside the propeller arc.

DATAFILE SPECIFICATIONS: CURTISS XF15C-1

POWERPLANTS

One Pratt & Whitney R-2800-34W radial piston engine, 2,100hp and one Allis-Chalmers/de Havilland (H-1B/J36) Goblin turbojet, 2,700lb thrust

DIMENSIONS

Span:	48ft 0in (14.63m)
Folded span:	20ft 5in (6.23m)
Length:	43ft 8.5in (13.32m); with ‘T-tail’ 43ft 9.4in (13.34m)
Wing area:	400 sq ft (37.20 sq m)

PERFORMANCE

Maximum speed (both engines running):	432mph (695km/h) at sea level, 469mph (755km/h) at 25,300ft (7,711m)
Maximum speed (piston engine only):	322mph (518km/h) at sea level, 373mph (600km/h) at 25,300ft (7,711m)
Service ceiling:	41,000ft (12,497m)
Maximum range:	1,385 miles (2,228km)

WEIGHTS

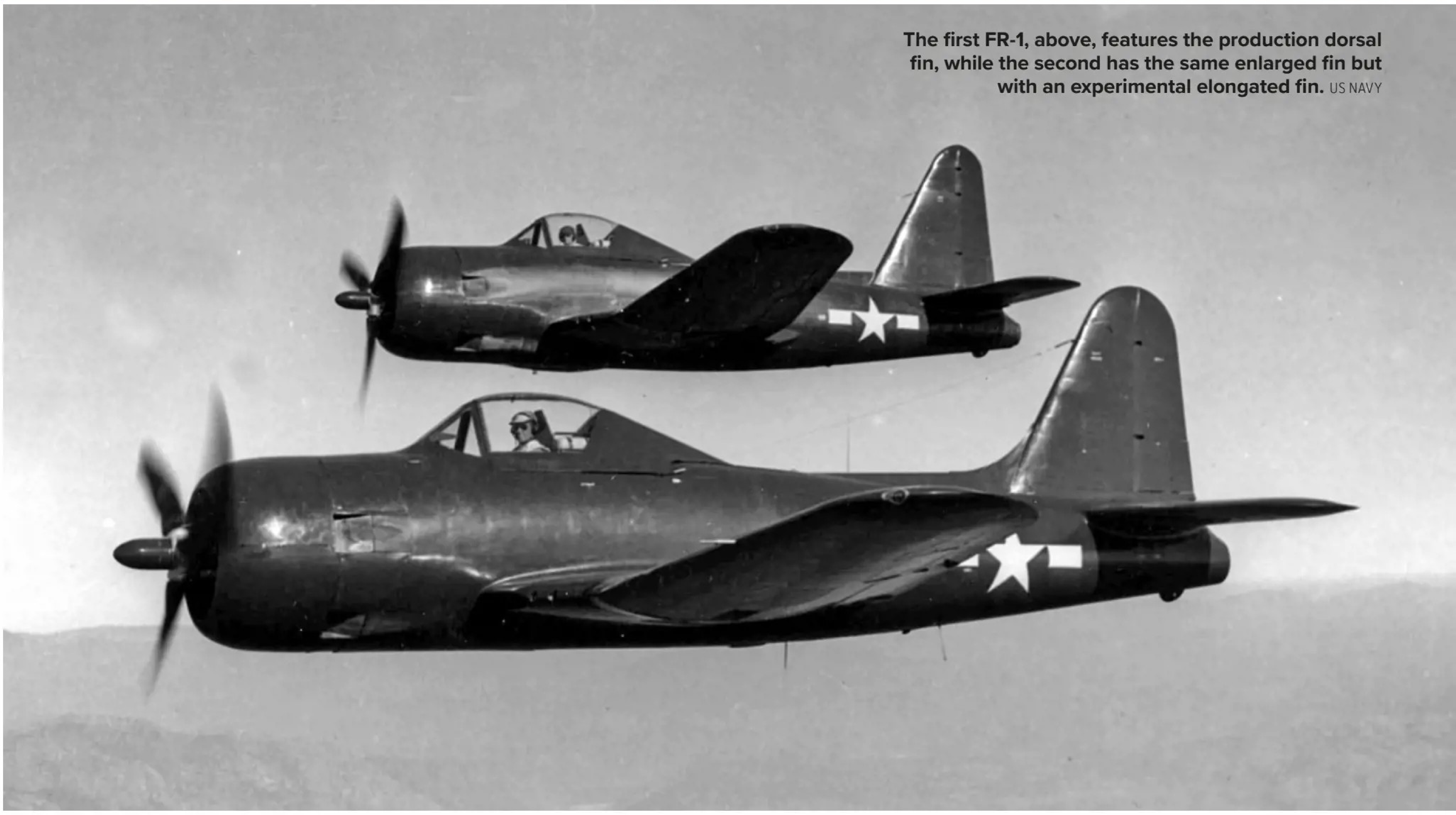
Gross:	16,630lb (7,543kg)
Maximum take-off:	17,691lb (8,025kg) as fighter, 18,698lb (8,481kg) as bomber

ARMAMENT

Four 20mm cannon, two 1,000lb (454kg), two 500lb (227kg), two 250lb (113kg) or six 100lb (45kg) bombs, or eight 5in (12.7cm) rocket projectiles

RYAN FR FIREBALL

Despite some useful performance attributes, the Fireball's service life proved limited



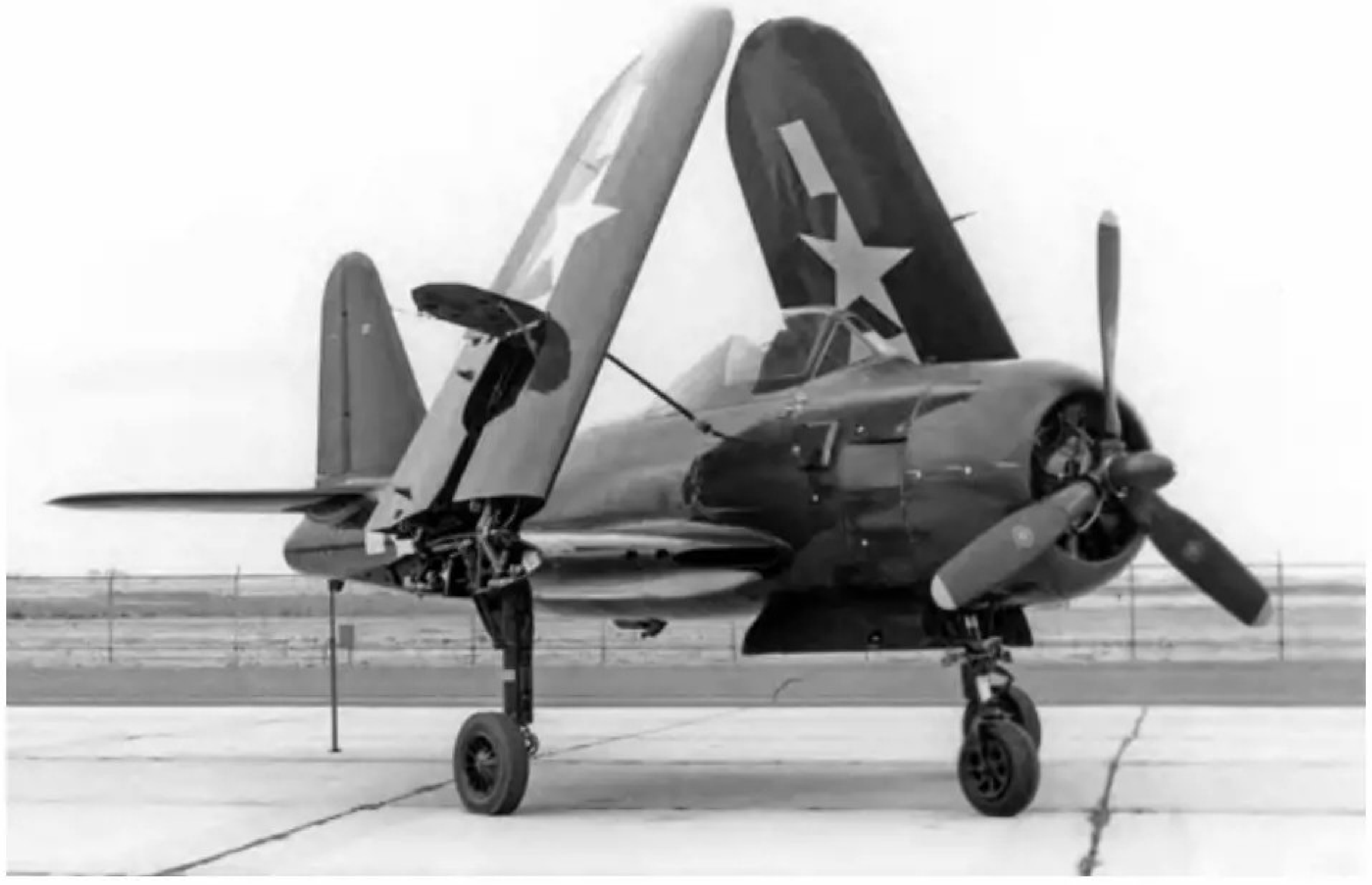
The first FR-1, above, features the production dorsal fin, while the second has the same enlarged fin but with an experimental elongated fin. US NAVY

The only type covered here to enter production and service was the Ryan FR Fireball. It was the BuAer's doubts as to whether a purely jet-powered fighter could operate successfully from carrier decks that prompted a competition for a dual-powered aircraft, fitted with both a piston engine and a jet. The winning design came from the Ryan Aeronautical Corporation, penned by Ben T. Salmon and William T. Immenschuh, and a contract for three XFR-1 prototypes (BuNos 48232-48234) plus a static test airframe was awarded on 11 February 1943, with the first and second examples to be delivered in 14 months. This was the US Navy's first aircraft to use a jet engine.

Such was the enthusiasm for the type, which was to be named Fireball, that a production order for 100 was placed on 2 December 1943. With the war in the Pacific still raging, in January 1945 this figure was increased to 700 FR-1s and 600 FR-2s. However, after Japan's surrender and the end of hostilities, these orders were cut back drastically, and in the end only 66 production Fireballs would be produced (BuNos 39647 to 39712). The first of these was also delivered in January 1945, and the last the following November.

Flight-testing and in service

The first XFR-1 prototype performed its maiden flight on 25 June 1944, though without the jet engine installed; this was fitted very soon afterwards and during July a number of flights were made with it. The second prototype followed on 20 September 1944 and the development programme proved to be fairly trouble-free. However, wind-tunnel testing in NACA's facility at Langley, Virginia had indicated that the original tailplane — based on the form fitted to the Grumman F4F Wildcat fighter — would, due to a miscalculation with the centre of gravity, afford inadequate longitudinal stability. Prototype testing continued with this original tailplane but several modified forms were assessed before one was cleared for the production run. In addition, flight trials showed that the original double-slotted flap was unsatisfactory, although all the prototypes plus 14 production machines had them before a single-slotted flap was introduced.



The wing folding mechanism has been engaged on an unidentified Fireball. VIA GERALD H. BALZER

Despite the advanced nature of the Fireball's design the prototype trials found few other problems, but the prototypes themselves were ill-fated. The first, BuNo 48232, was lost on 13 October 1944 when it crashed into Sycamore Canyon near San Diego while on a sortie from Naval Air Station China Lake, killing Ryan chief test pilot Bob Kerlinger. The resulting investigation revealed the Fireball wing structure lacked sufficient strength to resist the effects of compressibility, which resulted in the manufacturer increasing the number of rivets used in making the outer wing panels by 100 per cent. This weakness was established by new chief test pilot Al Conover who performed a set of trial dives to explore the theory, and which showed that certain parts of the airframe could get into compressibility effects. The same problem most likely caused the loss of BuNo 48233 on 25 March 1945 when

M. G. 'Mickey' McGuire was killed in this aircraft, in a dive he had commenced at 35,000ft (10,668m). And then on 5 April 1945 the third prototype crashed into a Consolidated PB4Y Privateer bomber on the ground after losing its canopy during a high-speed run across Lindbergh Field in San Diego, though happily on this occasion the pilot, Dean Lake, escaped successfully.

Trials and assessment by the NATC at Patuxent River began in October 1944 with prototype BuNo 48233, and highlighted further problems. One in particular, the overheating of the piston engine, resulted in the fitting of electrically operated cowl flaps. Carrier suitability and acceptance trials opened in early January 1945, also with 48233, on board the escort carrier USS *Charger* in Chesapeake Bay. Catapult launches were made using the piston engine alone and then with both engines running, and landing back aboard gave no trouble.

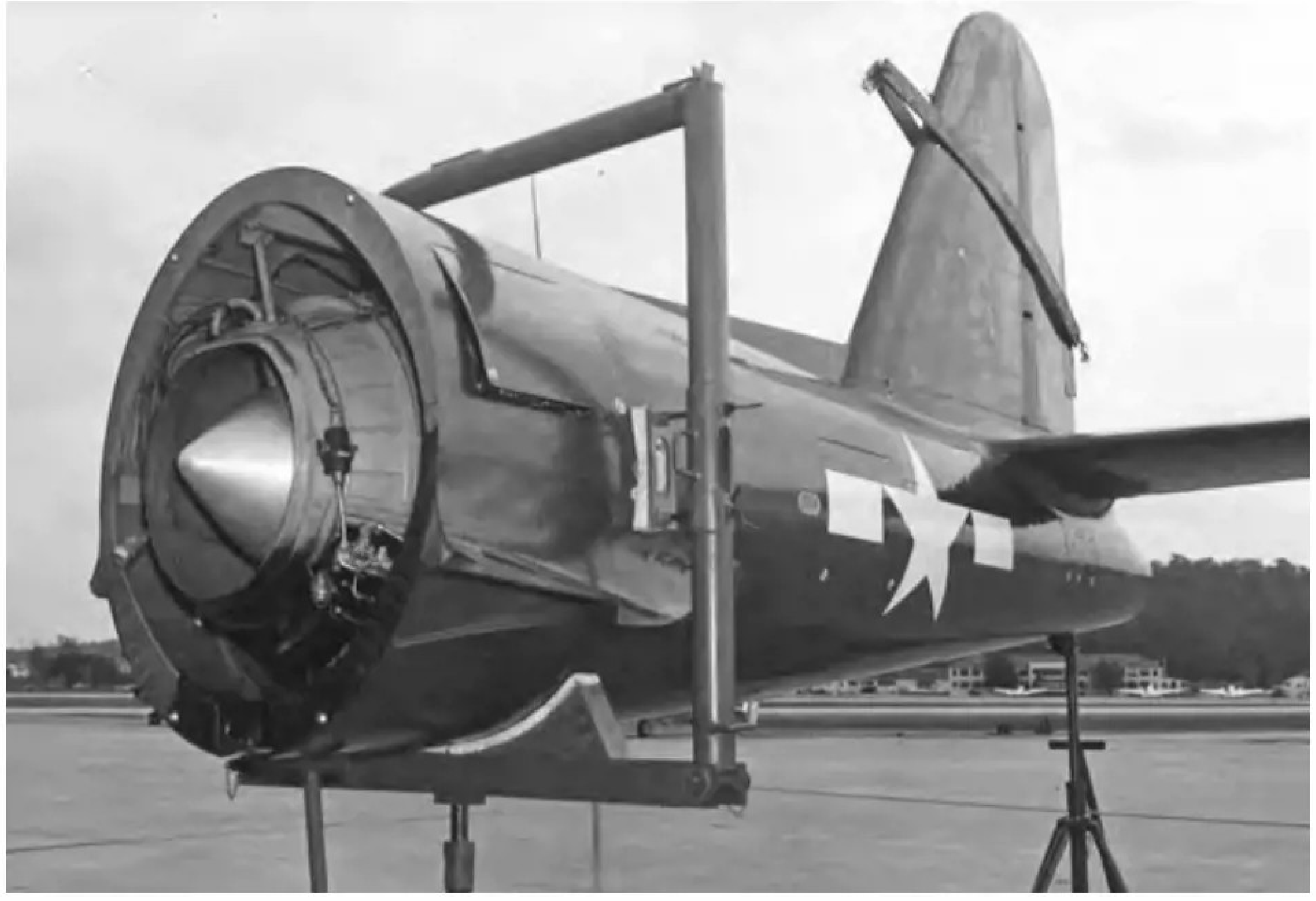
> ***"Events prevented the Fireball from seeing combat"***

Production aircraft BuNo 39651 was the first of nine also to be used for trials at Patuxent River, including 39656 which was given 11.5° of dihedral to the wing, a modification not adopted for production machines, 39660 on engine testing, 39667 for armament trials, and 39708 for service acceptance trials. From mid-February 1945 until 1 June 1947 production machines 39650, 39656, 39657, 39659, 39660 and 39665 were all assigned to the NACA Ames Aeronautical Laboratory at NAS Moffett Field to assess the Fireball's flying qualities, stability and control, and to establish its performance limits.

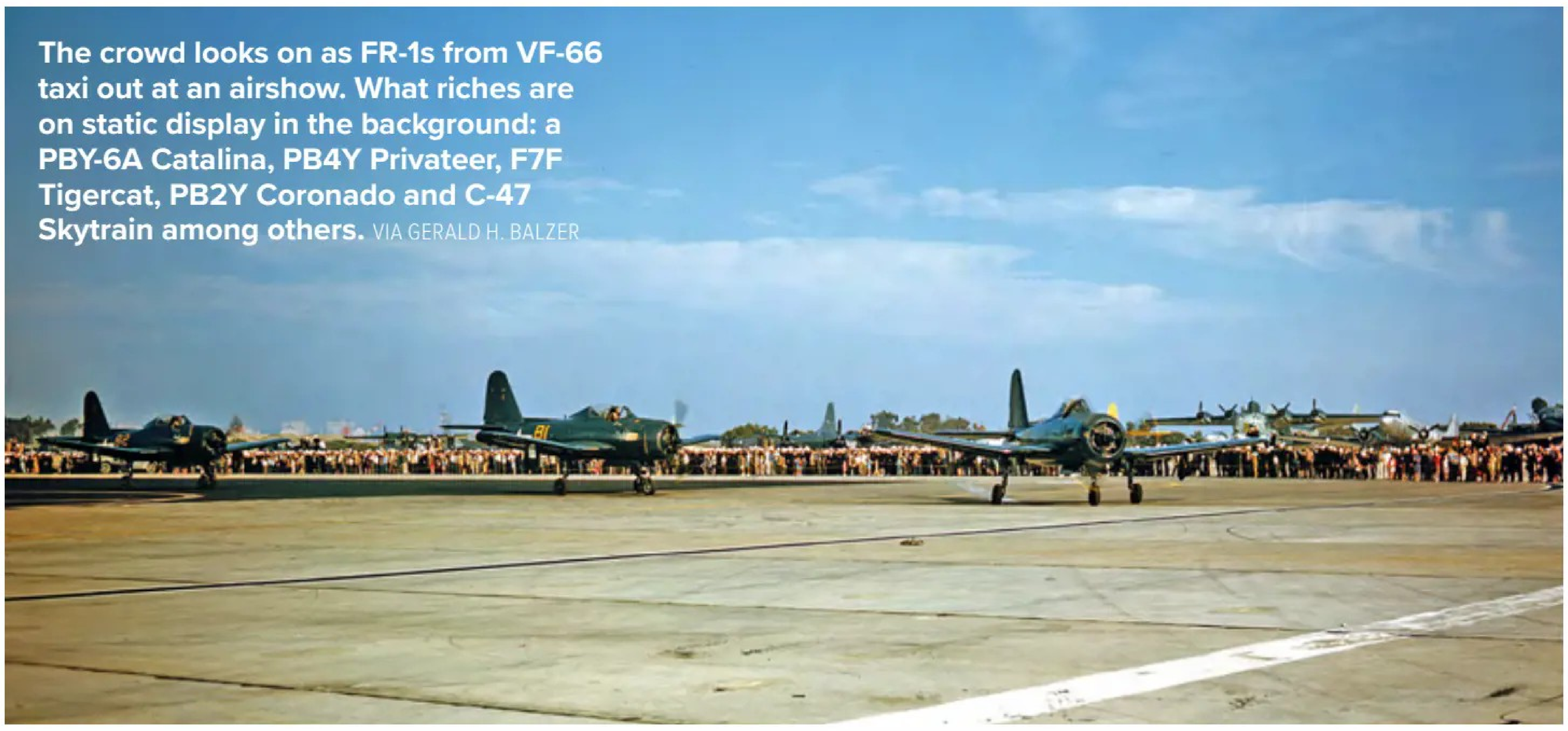
Only one US Navy squadron, VF-66, would be equipped with Ryan's dual-powerplant fighter. Initially there was a rush to get the type into service, crewed by very experienced pilots, so it could operate against Japanese rocket-powered Yokosuka MXY-7 Ohka kamikaze aircraft as soon as possible. The plan was to have the Fireball flying on a combat air patrol with just its piston unit running, but when an enemy aircraft was spotted the jet would be lit to enable the FR-1 to accelerate and make a quick interception to bring the enemy down. Ryan was in fact manufacturing production Fireballs in advance of final official testing, and it was intended to have the squadron operational in advance of all normal qualification requirements, but events prevented the type from ever seeing combat.

VF-66 began receiving Fireballs in March 1945 at NAS North Island, San Diego, which was also the home of the Ryan factory. On 1 May three of its aircraft were loaded aboard the USS *Ranger* in readiness to qualify pilots for carrier operation, but two were damaged in landing accidents. And then on 15 August 1945 Japan surrendered. The squadron was decommissioned on 18 October, but its aircraft and aircrew re-formed as VF-41 on 5 November. Now the pace of development was slowed

What appears to be the third prototype, BuNo 48234, flying with the Naval Air Test Center at Patuxent River and fitted with an enlarged spinner. VIA GERALD H. BALZER


A Fireball rear fuselage section in jigs with the J31 jet engine in place. VIA GERALD H. BALZER

Armed with two pairs of rocket projectiles, this Fireball is flying on jet power alone. VIA GERALD H. BALZER



The crowd looks on as FR-1s from VF-66 taxi out at an airshow. What riches are on static display in the background: a PBY-6A Catalina, PB4Y Privateer, F7F Tigercat, PB2Y Coronado and C-47 Skytrain among others. VIA GERALD H. BALZER

to something approaching normality. Ryan demonstrated the Fireball officially to the navy on 7 September, but it took until 6 April 1946 for the USN to formally state that the FR-1 demonstration had been completed satisfactorily.

In March 1946 the 16 Fireballs of VF-41 conducted qualification trials aboard the escort carrier *Bairoko*, but problems which had shown up with the nose undercarriage were present once again. There were also partial wing failures, which brought a decision to limit the Fireball to 5g manoeuvres. On 15 November 1946 VF-41 was redesignated VF-1E, but further signs of structural weakness brought a withdrawal from service by 1 August 1947; indeed, in June 1947 a Fireball had made a hard landing on Rendova Island which broke the aircraft into two pieces at the join where the removable rear fuselage met the forward fuselage. With the exception of selected airframes retained for modifications and trials, all of the Fireballs were soon scrapped.

The last flyable example was delivered to the Naval Air Technical Training Center at Memphis in April 1948 to be utilised as a maintenance training airframe. One, BuNo 39657, is preserved at the Planes of Fame Air Museum at Chino, California.

In the end the FR-1 lacked enough structural strength to operate aboard aircraft carriers, and did not offer a sufficient increase in pure speed or acceleration over standard navy fighters such as the Grumman F8F Bearcat. But it did possess a performance that was almost independent of altitude, an excellent rate of climb, and its high-speed manoeuvrability and turn radius were superior to any current combat aircraft of its time. Pilots took delight in feathering the propeller and then fooling onlookers and aircrew in other aircraft by making rapid passes and flying with seemingly no visible means of propulsion — the jet, of course, was still on the secret list, or afterwards was still little-known.

Three further variants of the Fireball were flight-tested with the object of improving the fighter's performance. They were the single XFR-2 conversion, fitted with a more powerful 1,500hp Wright R-1820-74W piston unit but not taken to production, the XFR-4 and then the XF2R-1 (the proposed XFR-3 with an I-20 jet engine was not flown). The XFR-4 was powered by an R-1820-74W piston engine and a 3,400lb-thrust Westinghouse J34-WE-22 (24C) jet, the latter requiring a wider and stretched end fuselage which made the aircraft some 8in (0.20m) longer overall. Flush air intakes were positioned on the fuselage sides, replacing the Fireball's wing-root air intakes. Removing the wing intakes made for a straight wing leading edge, and the fin was taller. When the jet was not running the new inlets would be closed off to cut drag — they would open when the pilot began the sequence to start up the J34.

BuNo 39665 was the aircraft thus modified, some sources stating it first flew in November 1944. The aircraft was assigned to the NACA Ames Aeronautical Laboratory at Moffett Field between 17 February 1945 and 1 June 1947 and was used to assess the flying qualities, stability and control and performance with this more powerful jet installed. Sources suggest the XFR-4 was some 100mph (161km/h) faster than the standard Fireball.

Technical details

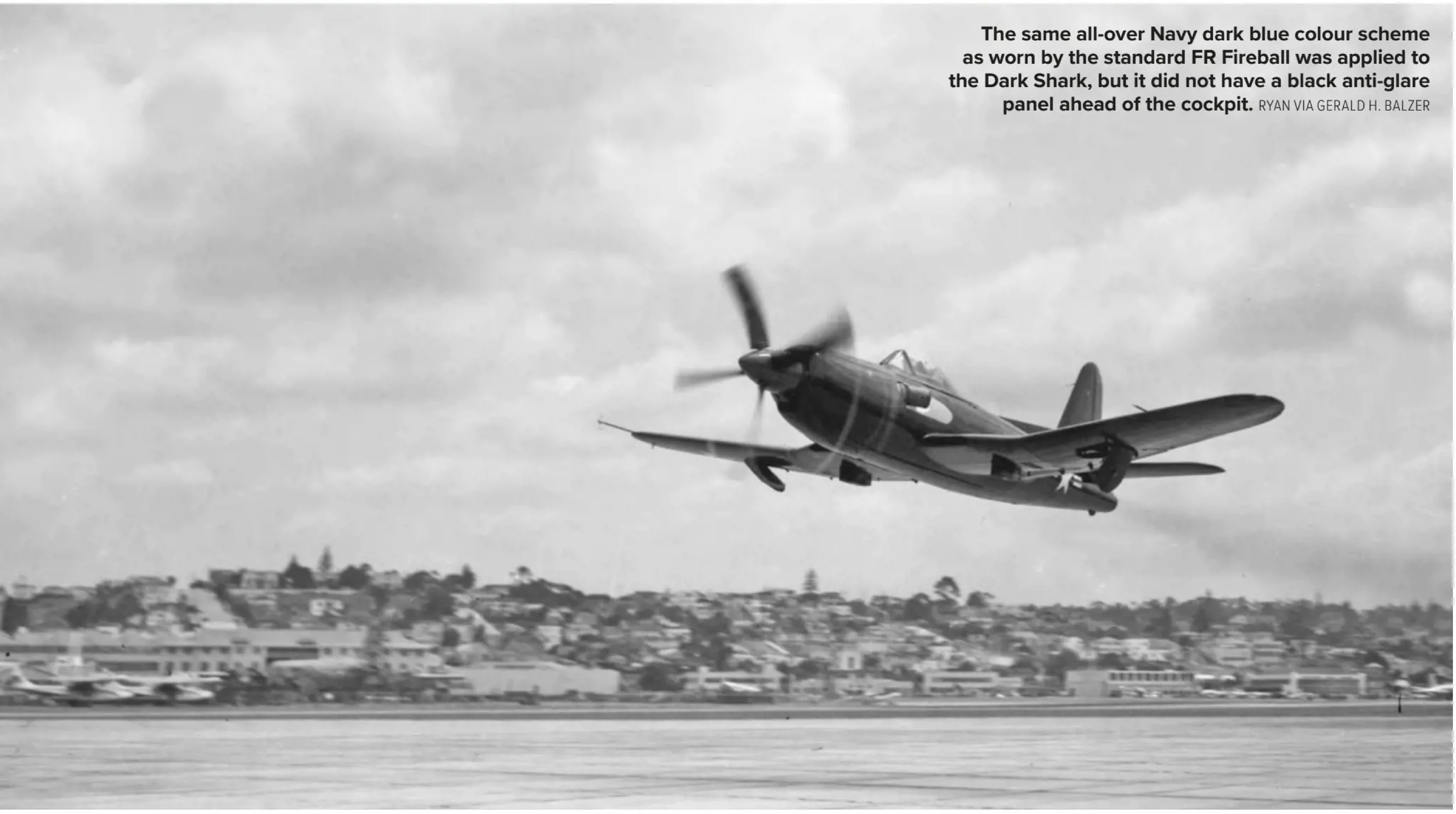
The FR Fireball was the US Navy's first carrier-based aircraft to use a laminar-flow wing and the first to have a tricycle undercarriage, the jet in the rear fuselage blocking any possibility of fitting a tailwheel. With the main gear retracting outwards into the outer wing panels and the jet air intakes positioned in the wing leading edge roots, the tapered cantilever wing itself had to be relatively thick with a thickness-to-chord (t/c) ratio at the root of 17 per cent and 15 per cent at the tip. The wing was designed such that the entire surface would reach its critical Mach number all at the same moment, thus hopefully preventing any tendency that the fighter might tuck under when diving. The all-metal fuselage and wing skin was entirely flush-riveted to produce a very smooth surface.

The Wright R-1820-72W Cyclone piston engine was housed in the nose and the General Electric I-16 turbojet in the end fuselage; the fuselage had two fuel tanks of 130-US gallon (492-litre) and 50-US gallon (189-litre) capacity respectively. If wishing to use just one of the engines, the pilot could switch back and forth between the piston and jet. The wing-root air intakes limited the space for fixed armament to just four machine guns, mounted in the wing outboard of the intakes. Provision was available to carry four rocket projectiles under each outer wing, while underwing hardpoints inboard of the undercarriage could each take a 1,000lb (454kg) bomb or a 100-US gallon (379-litre) drop tank.

DATAFILE SPECIFICATIONS: RYAN FR-1

POWERPLANTS	
One Wright R-1820-72W Cyclone nine-cylinder air-cooled radial piston engine, 1,350hp and one General Electric J31-GE-3 turbojet, 1,610lb thrust	
DIMENSIONS	
Span:	40ft 0in (12.19m)
Folded span:	15ft 11in (4.85m)
Length:	32ft 4in (9.85m)
Wing area:	275 sq ft (25.5 sq m)
PERFORMANCE	
Maximum speed (as fighter):	404mph (650km/h) with both engines, 276mph (444km/h) at 19,000ft (5,791m) with piston engine only
Service ceiling:	43,100ft (13,137m) with both engines, 27,500ft (8,382m) with piston engine only
WEIGHTS	
Gross:	10,652lb (4,832kg) as fighter with one 100-US gallon (379-litre) tank, 11,652lb (5,285kg) as bomber with one tank and 1,000lb (454kg) bomb
ARMAMENT	
Four 0.50in (12.7mm) Browning machine guns, eight 5in (127mm) rocket projectiles under wings, two 1,000lb (454kg) or 500lb (227kg) bombs	

Poor reliability scuppered this turboprop/turbojet



The same all-over Navy dark blue colour scheme as worn by the standard FR Fireball was applied to the Dark Shark, but it did not have a black anti-glare panel ahead of the cockpit. RYAN VIA GERALD H. BALZER

The follow-on XF2R-1 resulted from a BuAer requirement to combine a turboprop with a turbojet in the design of a single-seat fighter. The 15th Fireball, BuNo 39661, was heavily reworked to take a General Electric XT31 (TG100) turboprop driving a propeller, to compliment the J31 (I-16) jet. This altered the aircraft's appearance considerably, though in fact, from the front spar beneath the cockpit rearwards, it was essentially a Fireball airframe. There was an extended dorsal fin fillet to handle the increase in torque, both from the heavy propeller and from the turboprop's spinning turbine wheel. Apart from the longer body the aircraft's dimensions were unchanged, though the extra length (2ft 6in, 0.762m) did give the illusion of pushing the wing rearwards.

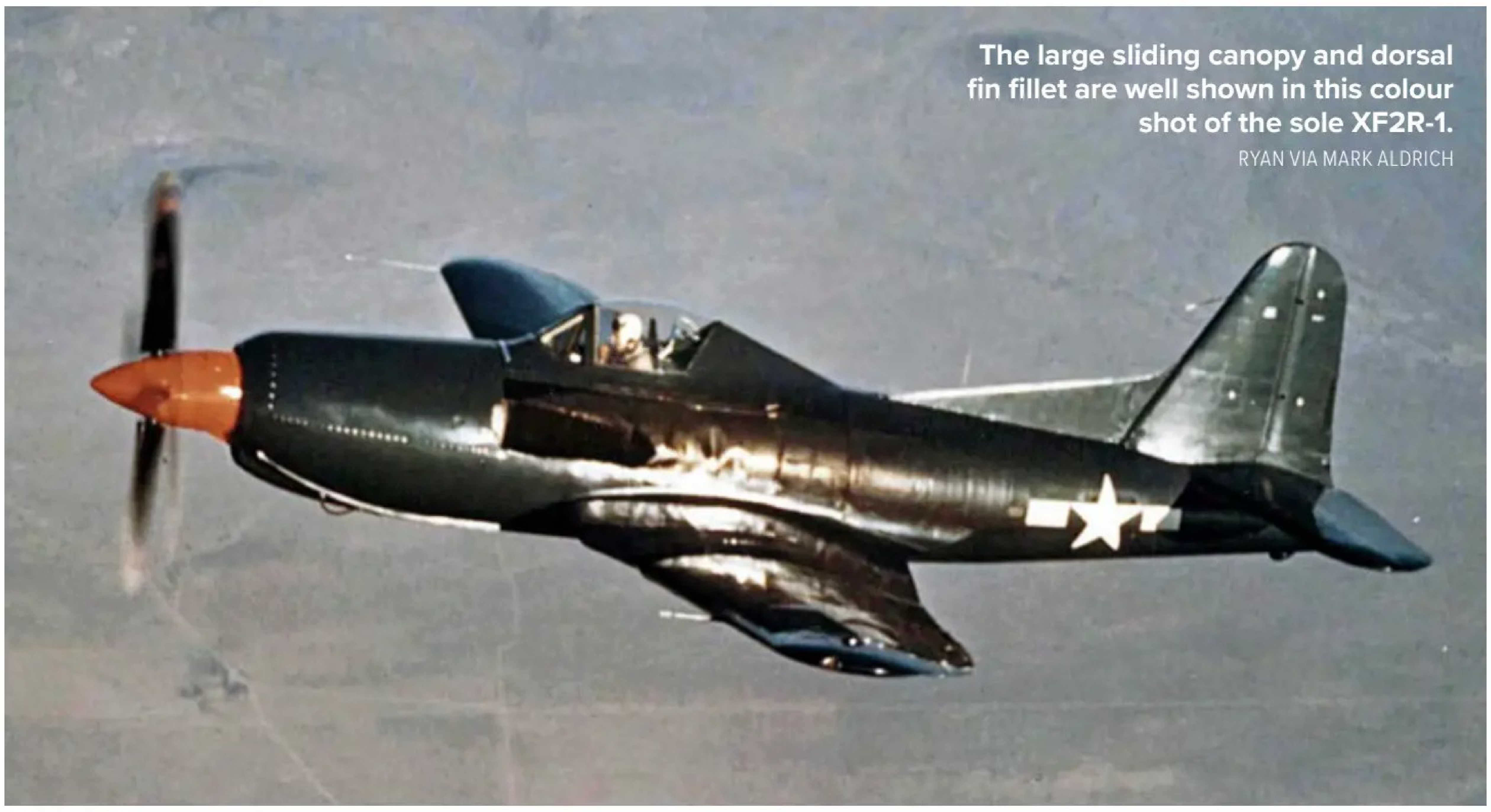
Introducing a turboprop meant only one type of fuel need be carried: kerosene. In addition, the Hamilton Standard propeller could be set to a very flat pitch which would serve as a dive brake for landing, while in the air the power was controlled by propeller pitch, so engine/aircraft acceleration and deceleration became near-instantaneous. In the Fireball the latter was slower because the propeller was turned by a reciprocating engine.

The new type was revealed to the public in February 1947, by which time it was being called the 'Dark Shark Fireball.' Contemporary articles also indicate the XF2R-1 was serving strictly as an experimental flying laboratory to acquire operational experience with this type of powerplant and propeller. Ryan proposed an XF2R-2 version in August 1945 with a J34 jet installed, and this was built in mock-up form before being rejected. BuNos 39713 and 39714 were allotted to further XF2R-1s but were cancelled.

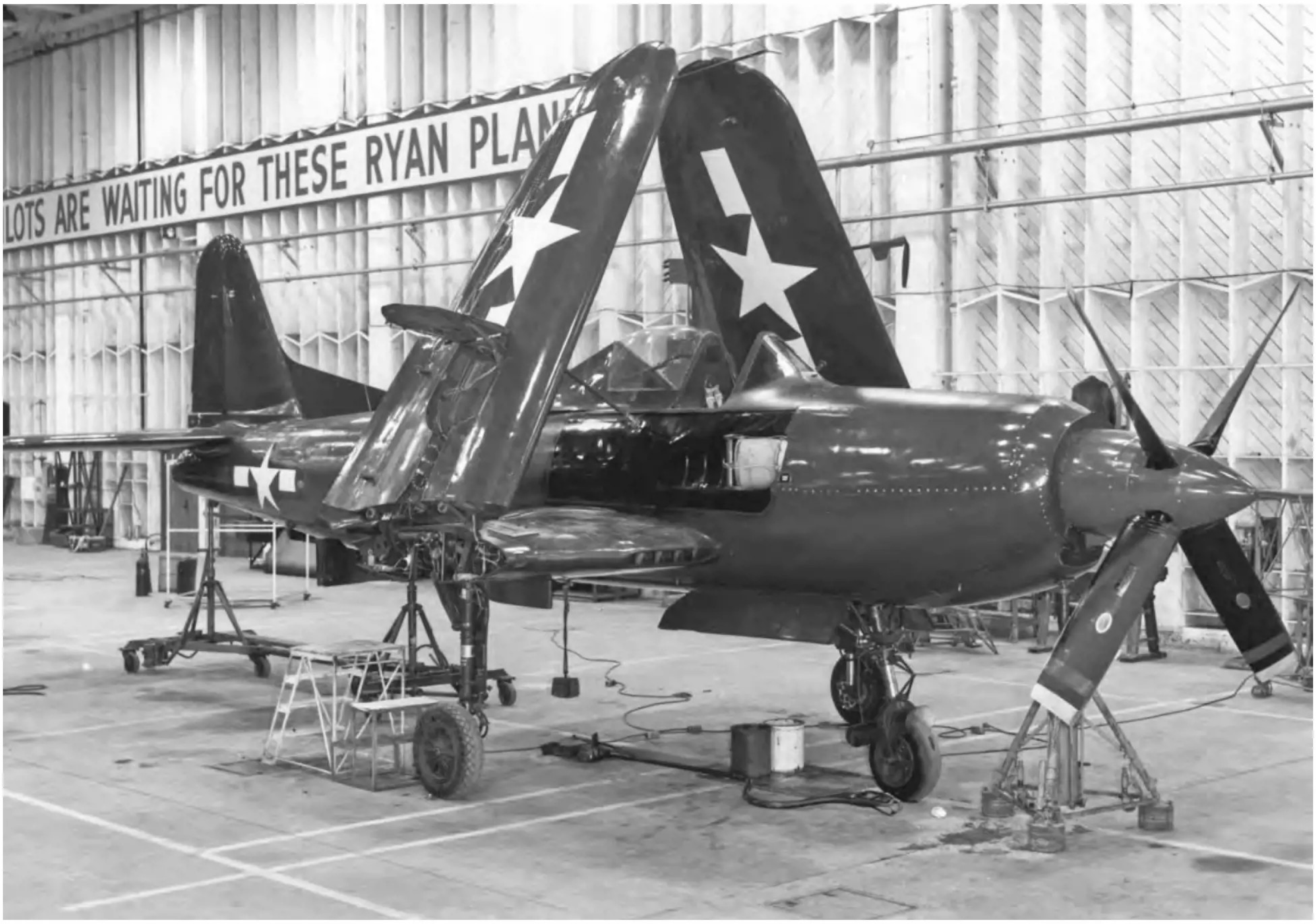
Flight-testing

The Dark Shark first flew in November 1946 with Ryan test pilot Alan Conover in the cockpit. As the first US Navy turboprop aircraft to fly it demonstrated some impressive performance attributes with, in particular, an excellent rate of climb. Ryan's flight test report from April 1947 said the aircraft was restricted from carrier-type landings and its wing fold mechanism and arrester hook had been removed. Nor was it fitted with dive recovery flaps, so high-speed dives had to be entered with caution.

While performing early diving trials a maximum Mach number slightly exceeding



The large sliding canopy and dorsal fin fillet are well shown in this colour shot of the sole XF2R-1. RYAN VIA MARK ALDRICH



The Dark Shark receives maintenance with its wings fully folded. "Pilots Are Waiting For These Ryan Planes" reads the sign on the hangar wall!
RYAN VIA MARK ALDRICH

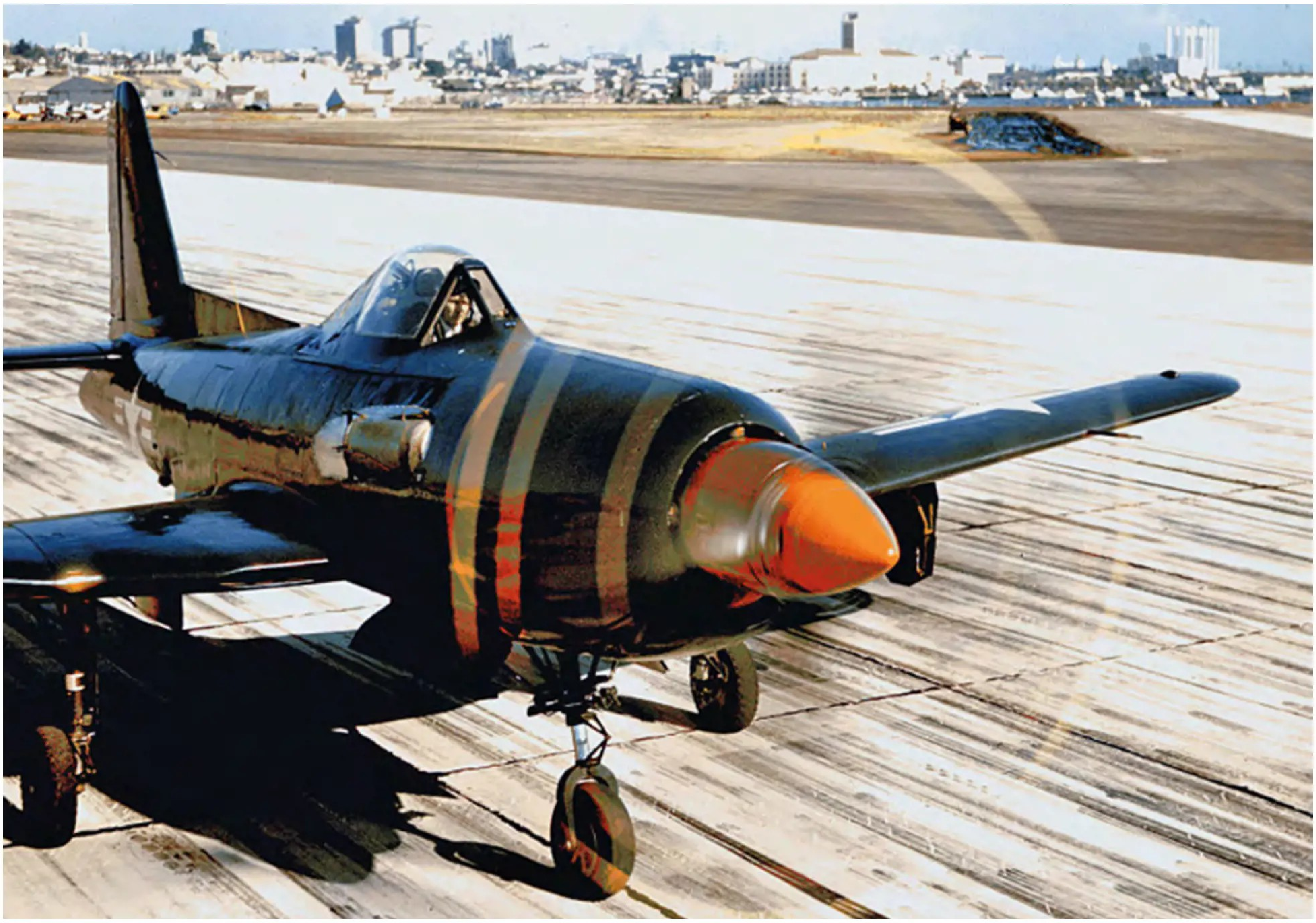
0.73 was obtained and the XF2R-1 had a definite tendency to tuck under. During a dive in which compressibility was encountered, it was generally not recommended to use the trim tab for recovery because of the possibility of exceeding the aircraft's structural limitation as the Mach number became lower. Since the aircraft could be recovered from a Mach 0.7 dive without the use of trim tab, and without excessive stick forces, it was recommended the XF2R-1 be restricted to a maximum Mach number of 0.7.

In a dive with a full 100-US gallon (378-litre) drop tank attached beneath the starboard wing centre section the XF2R-1 remained steady until 400mph (644km/h) indicated had been reached, unlike the FR-1 in the same configuration. At this speed lateral and directional stability became affected and the aircraft began to weave, roll and yaw because of the airflow over the tank. Given the impact on stability, it was recommended that this be considered the maximum attainable speed. The demonstration flying had begun with flight 20 on 4 April 1947 and the maximum weight during the trials was 11,830lb (5,366kg). The maximum recorded level speed appears to have been 460mph (740km/h) indicated, or 462mph (743km/h) true.

> *"Care had to be taken when flying slowly in a high-drag configuration"*

Because of the very high levels of torque with the TG100 installation, caution had to be taken while flying the aircraft slowly in the high-drag configuration — the power approach condition could be dangerous unless the stall warning was heeded and the recovery controls used decisively. With a power approach and gear and flaps down the stall came at 77mph (124km/h); the starboard wing had a tendency to drop until the stall occurred, and then the port wing dropped quickly, but this could be controlled by rapid movement of the rudder. With the drop tank in place a stall occurred at 78mph (126km/h).

The TG100's propeller could be fully feathered or reversed to zero blade angle very rapidly, the drag of the flatter blade angle serving as an effective airbrake. In fact the XF2R-1 was used to help demonstrate this new system of 'braking' an aircraft's speed in the air by flattening the pitch of the propeller during the final landing approach. This unique system, made possible by the huge propeller, could be used during landings to supplement the drag created by the aircraft's wing flaps. The XF2R-1's propeller had a much greater blade area compared with previous versions of the Fireball, and a diameter of 11ft (3.35m) compared to the FR-1's 9ft 6in (2.90m) three-blade unit. Also the Dark Shark, like the Fireball, could fly on jet power only. In this case the propeller would be 'feathered' by changing the blade angle so the chord lay in the direction of flight. As such the blades acted as brakes to



Later in its flying career the XF2R-1 prototype sported updated national markings with red bars, plus a new red warning stripe around the forward fuselage just ahead of the cockpit. RYAN VIA GERALD H. BALZER

stop the propeller and turbine wheel from rotating, while at the same time offering as little drag as possible.

Although the Dark Shark flew well, its TG100 turboprop proved to be quite unreliable and again — akin to the XP-81 — instead of providing the expected 2,200hp, in general it gave no more than 1,700hp. By the time the prototype had completed what was a protracted flight test programme, a decision had been taken not to put the fighter into production. The one and only XF2R-1 prototype was scrapped.

Technical details

The XF2R-1 Dark Shark was a single-place, low-wing monoplane. Its TG100 turboprop drove a four-blade Hamilton Standard Super Hydromatic fully feathering constant speed propeller, the hollow-steel paddle blades of which were square-tipped. A streamlined spinner gave something of a shark-nosed shape to the front end, and in the rear fuselage was the I-16 jet. About 75 per cent of the turboprop power was absorbed by the propeller, the remainder of the energy being converted into around 550lb of residual thrust by a jet exhaust stream ducted into nozzles exiting to each side of the fuselage. Essentially the XF2R-1 reused the Fireball's main body and flying surfaces; the span was unchanged but the length grew. A tricycle undercarriage was fitted but all the armament had been removed, though shackles beneath the wings could take 1,000lb (454kg) bombs or 100-US gallon (378-litre) drop tanks. The prototype did not have catapult attachments or an arrester hook.

DATAFILE SPECIFICATIONS: RYAN XF2R-1

POWERPLANTS

One General Electric XT31-GE-2 (TG100) turboprop, 2,220hp plus 550lb thrust, and one General Electric J31-GE-3 (I-16) turbojet, 1,600lb thrust

DIMENSIONS

Length:	36ft 0in (10.97m)
Span:	42ft 0in (12.80m)
Folded span:	17ft 5.5in (5.32m)
Wing area:	305 sq ft (28.365 sq m)

PERFORMANCE

Maximum speed:	497mph (800km/h) at sea level — estimated, both engines running
Rate of climb:	4,850ft (1,478m) per minute at sea level
Service ceiling:	39,100ft (11,918m)

WEIGHTS

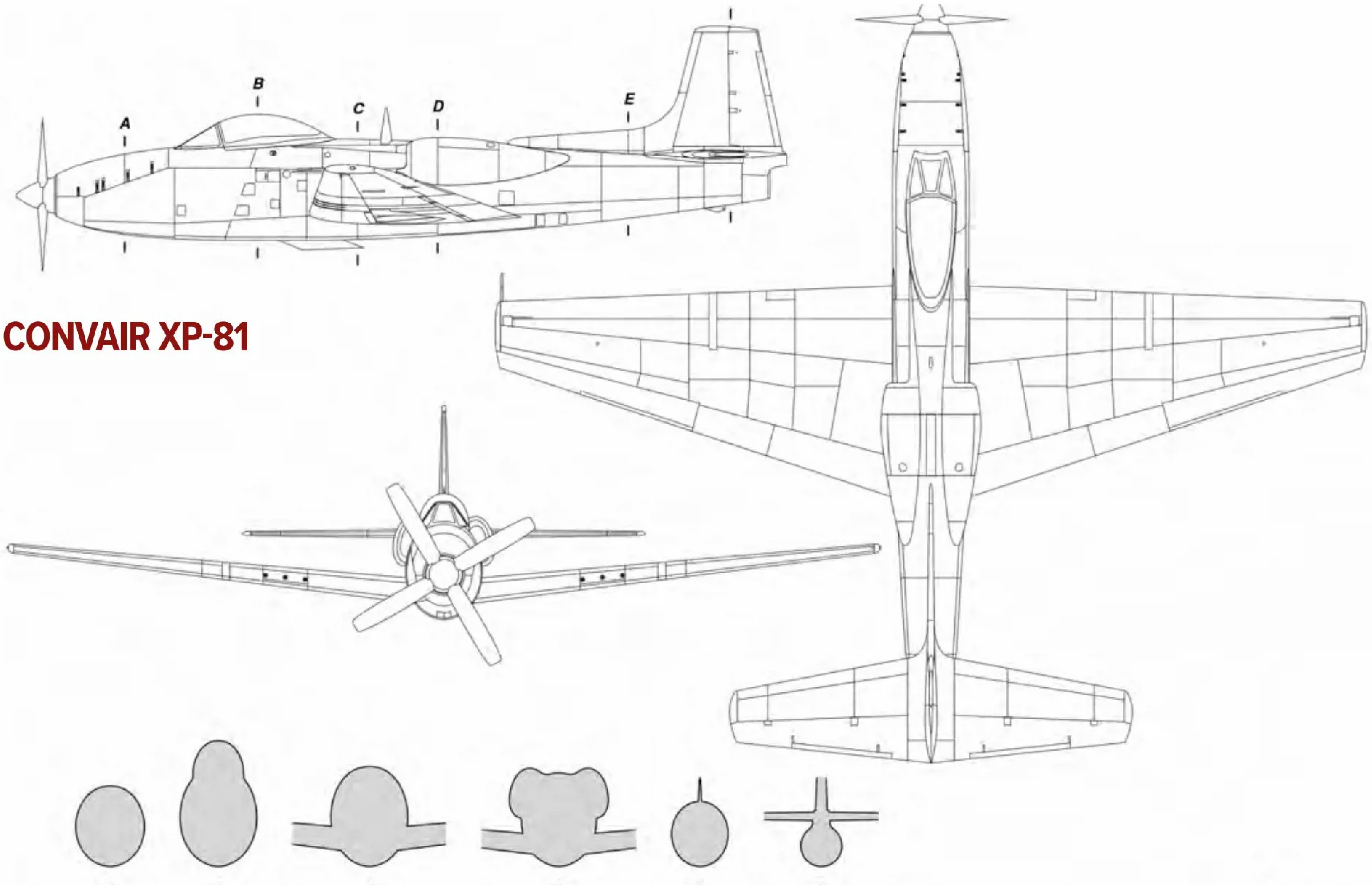
Gross:	11,000lb (4,990kg)

ARMAMENT

Four 0.50in (12.7mm) guns in wings — not fitted; production aircraft to carry bombs or unguided rockets under wings

The author acknowledges the help of Alan Griffith, Mark Nankivil, the late Gerry Balzer, Joe Baugher, Steve Ginter's books and the US National Archives at College Park.

CONVAIR XP-81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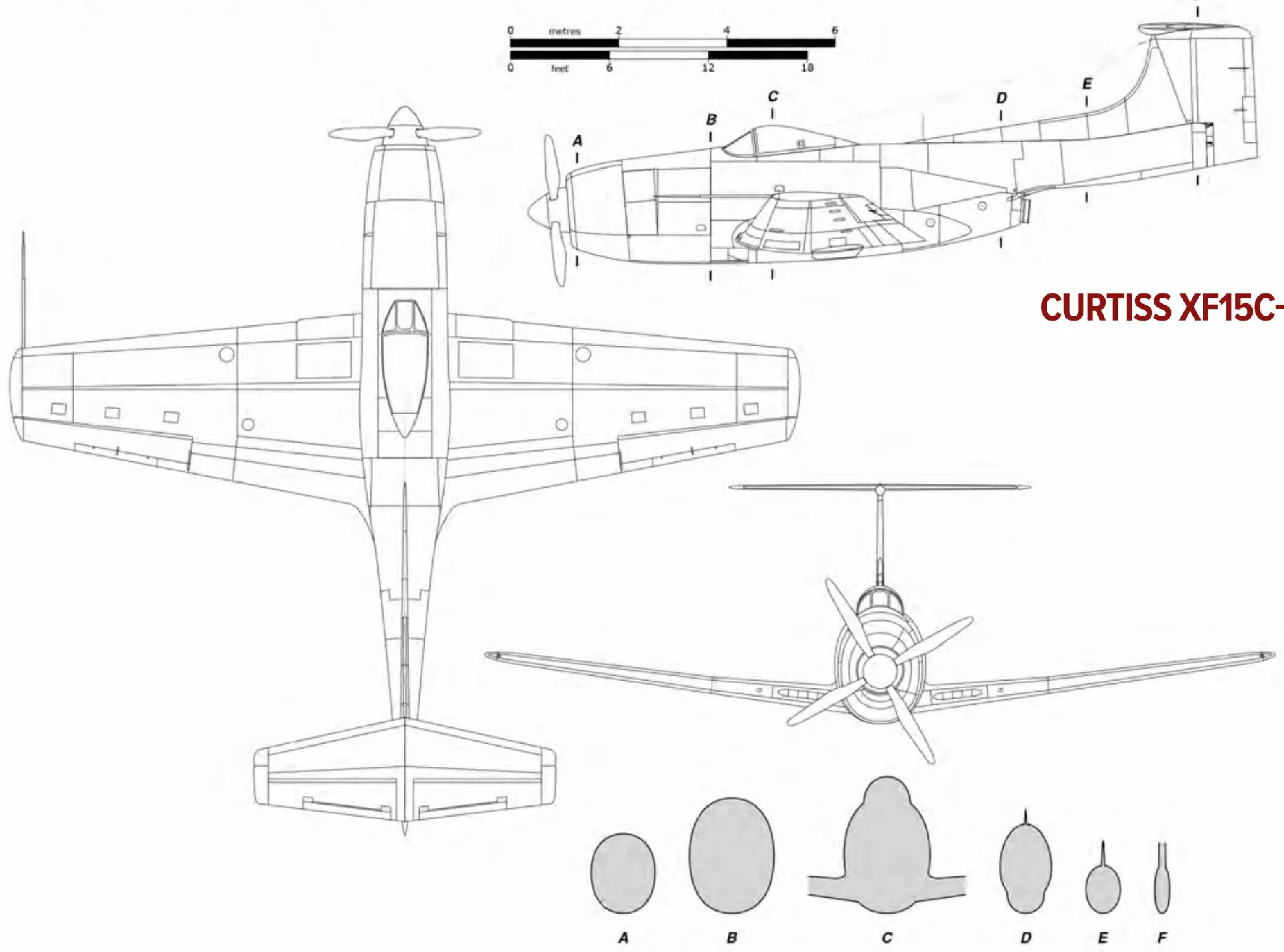
CURTISS XF15C-1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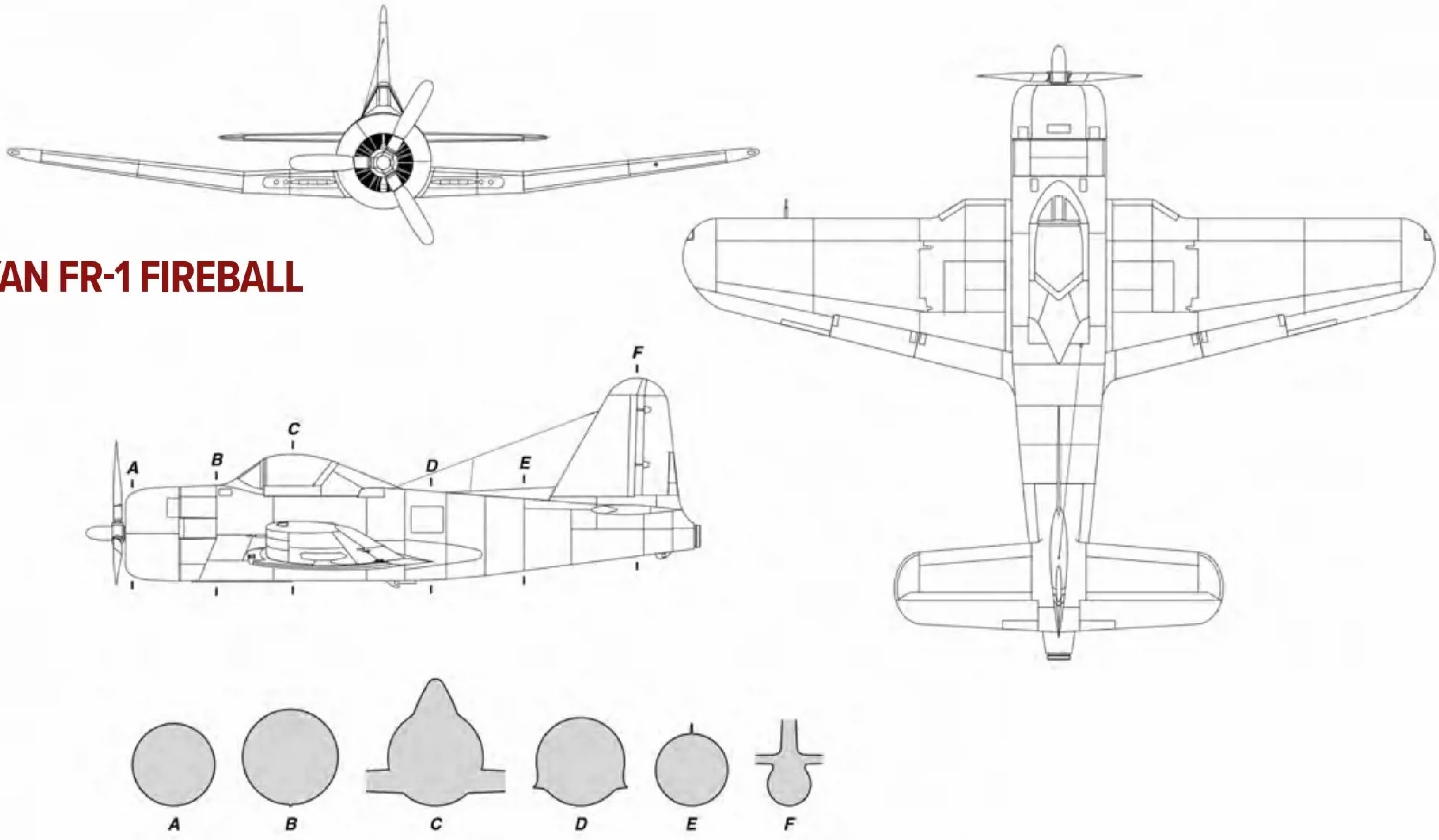
RYAN FR-1 FIREBALL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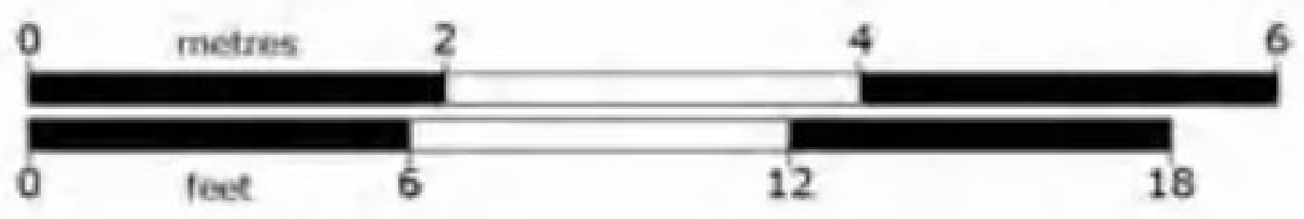
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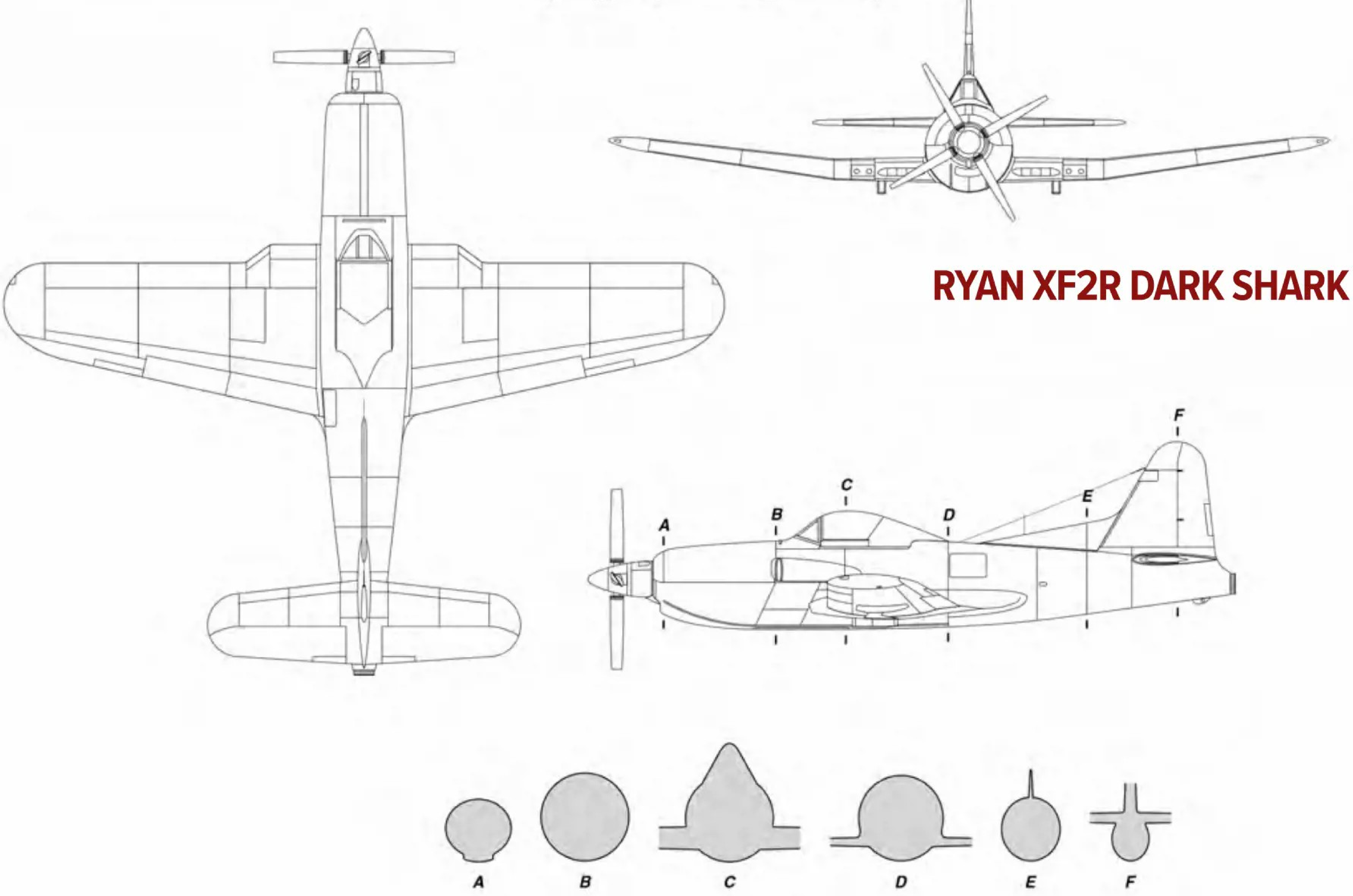
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Reviews

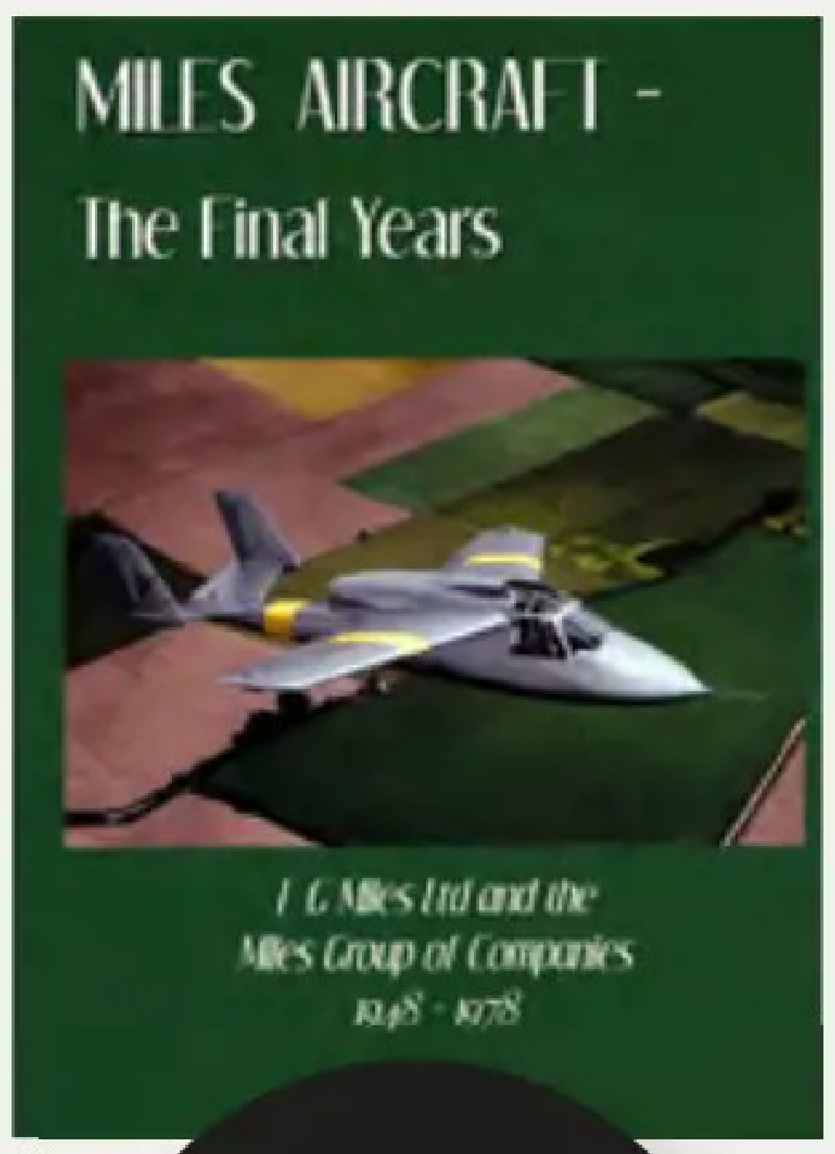
REVIEWS RATING

★★★★★ Outstanding
★★★★☆ Excellent
★★★☆☆ Good
★★☆☆☆ Flawed
★☆☆☆☆ Mediocre
Enough said

The latest books for the discerning aviation enthusiast

Miles Aircraft: The Final Years

by Peter Amos
published by Air-Britain


MILES AIRCRAFT -
The Final Years
F. G. Miles Ltd and the Miles Group of Companies 1948 - 1978

BOOK of the MONTH

Subtitled 'F. G. Miles Ltd and the Miles Group of Companies 1948-1978', this is the fourth and final volume of the set which details — and in what detail — the story of Miles Aircraft and its products. Volume 3 ended with the company in dire straits, 'restructuring' to emerge in slimmed-down form at Redhill as F. G. Miles Ltd. The new firm, registered on 4 December 1948, had only a small number of employees but plenty of hangar space. Its initial remit was to look after the Miles aircraft still in use. An evocative advertisement, reproduced on page 18, from 1950 promoting the company as "specialists in service to the private owner" has a pencil-drawn illustration of a gleaming Hawk Trainer with the legend, "Wonderful what a drop of paint will do".

With legal wrangles only finally out of the way in the spring of 1950, the company looked to identify holes in the aviation market that it might profitably fill. The M74 Surrey, a four-engined design looking much like an enlarged Aerovan and intended as a replacement for the Dragon Rapides in BEA service, came to nothing. There followed the M77 Sparrowjet, a conversion of the earlier Sparrowhawk racer of 1935 to fit two Turbomeca Palas turbojets of 330lb thrust apiece. Its crowning achievement was victory in the 1957 King's Cup air race, when Miles aircraft took four of the top five places. Miles returned to Shoreham in 1951, where it embarked on development of the M100 Student, a jet trainer that was also proposed as a light attack aircraft. Like too many Miles projects, it never made it into production.

The sheer ingenuity of Miles's thinking is evident throughout, and Amos's account excels in giving the story behind the many projects alongside the technical aspects, accompanied by a superb set of illustrations. Wonderfully readable, by any criterion this concluding volume deserves its five-star rating. ***Denis J. Calvert***

ISBN 978-0-85130-558-5; 12.0 x 8.6in hardback; 240 pages, illustrated; ***£52.50*** *(Air-Britain members* ***£35.00****)*

★★★★★

Fiat Aeritalia Fighters

by Luigino Caliaro
published by
Classic/Crécy Publishing

FIAT
FIGHTERS
CR32 · CR42 FALCO · G50 FRECCIA · G55 CENTAURO
LUIGINO CALIARO

The second part of a trilogy by the author and publisher covering Second World War fighters from Italy's main manufacturers is greatly to be welcomed. In tackling Fiat's CR32 and CR42 biplanes and G50 and G55 monoplanes, four of the most illustrious such machines, there's a lot to get through here whether in terms of design or service, but it's difficult to imagine a better job being done. Each is afforded its own detailed chapter, taking in their gestation and operational activities, whether in Italy or elsewhere. Other chapters deal with the Corpo Aereo Italiano, the Regia Aeronautica air corps dedicated to operations against the UK, use of Fiat fighters by training units, post-war service, the G55's adaptation into the G59 trainer, camouflage and markings, and surviving airframes. Phew!

We reviewed Caliaro's *Macchi Fighters* book extremely favourably, and many of the same comments apply here. This is not least with regard to the range of photos, being as it is very impressive — wartime colour shots of a Croatian G50bis, anyone? — and well-reproduced. The text reads well, but one interesting point is that the author styles Fiat in capitals, which is technically correct — it's an acronym standing for Fabbrica Italiana Automobili di Torino — but a little anachronistic. As one would expect from Crécy, the layout is most attractive, though I was surprised to see that the typeface used for the main text has been changed when compared with the Macchi volume. The new one is, in my view, less attractive and, at the point size employed, not so readable. But such minor quibbles can be left to one side as one enjoys by far the best English-language book on these important aeroplanes. ***Ben Dunnell***

ISBN 978-1-80035-312-1; 12.25 x 9.25in hardback; 288 pages, illustrated; ***£40.00***

★★★★

Air Campaign: South Atlantic 1982

by Angus Konstam
published by Osprey

AIR CAMPAIGN
SOUTH ATLANTIC
1982
The carrier campaign in the Falklands War
ANGUS KONSTAM

More than 40 years after the Falklands war, books continue to appear on the subject. This one, from Osprey, examines the air campaign and the role played by the three aircraft carriers involved: HMS *Hermes*, HMS *Invincible* and ARA *Veinticinco de Mayo*. The text underlines just how valuable the carriers were — the loss of either Royal Navy vessel would have had a massive impact on the British chance of success in retaking the Falklands. In the best Osprey traditions, it offers a review of the aircraft and weaponry available to both sides, the all-important order of battle — which showed a numerical advantage in aircraft to Argentina — and some useful maps, diagrams and drawings. One such diagram underlines the fact that the combination of Sea Harrier with the AIM-9L Sidewinder was the winning combination of the war, giving the 'Shar' the ability to acquire a target and attack from any aspect.

The author's examination is both exhaustive and impartial and backed up with well-reproduced photos in colour and black-and-white. No real negative points, although the Argentinean carrier is misspelt ('Veintecinco') in places and the contention on page 12 that Argentinean Canberras "were equipped for mid-air refuelling" is surely open to question. ***DJC***

ISBN 978-1-4728-6471-0; 9.8 x 7.3in softback; 96 pages, illustrated; **£16.99**

★★★

RFC/RAF Airfields, Landing Grounds and Other Sites in Nottinghamshire

by Colin Savill
published by Colin Savill

RFC/RAF AIRFIELDS, LANDING GROUNDS AND OTHER SITES
in Nottinghamshire
Colin Savill
RETFORD OSSINGTON PLUNGAR
BAWTRY WATNALL ORSTON
HUCKNALL NEWARK NOTTINGHAM

Privately published, this nicely produced, laminated-cover softback does exactly what it says on the tin. Or, indeed, in the title. In 96 pages, it reviews 38 sites — mostly, but not all, airfields — used by the RAF and its RFC predecessor in the county of Nottinghamshire, along with a few organisations: maintenance units as well as the little-known Polish Resettlement Corps. Of the airfields, the names of Finningley, Bawtry and Syerston will be familiar but those of Plungar, Thurgaton and Wigsley likely less so except, perhaps, to locals. Each is accorded anything between a quarter-page, for RFC Ruddington, to the four pages rightly given over to Finningley's long and varied history. For each, the author provides a useful summary of its history along with a tabular presentation of the period of use, a comprehensive listing of based squadrons/units and the aircraft types used. A useful bibliography appears as a concluding section. Photo reproduction onto glossy paper stock is very good and compares favourably with that from a number of major aviation publishing houses. All in all, an excellent package, available from the Newark Air Museum. ***DJC***

ISBN 978-1-9996353-2-9; 9.8 x 7.3in softback; 80 pages, illustrated; **£12.00** *from Newark Air Museum (www.newarkairmuseum.org)*

★★★

Captain de Havilland's Moth

by Alexander Norman
published by Abacus

ALEXANDER NORMAN
CAPTAIN DE HAVILLAND'S MOTH
Tales of High Adventure from the Golden Age of Aviation

The centenary of the DH Moth's maiden flight deserves the release of a new title on this outstanding aeroplane, such a milestone it represented in light aviation. Of course, Moth Club supremo Stuart McKay's numerous volumes on the family remain the standard reference works. But the offering by this author, one of a lengthy line of Moth pilots within his family — his father was Desmond Norman of Britten-Norman fame, and one of his uncles Torquil Norman, long-time Moth owner — offers something different. Rather than a run-of-the-mill type history, one is introduced not just to the DH60 itself, but some of those inter-war characters for whom it was the mount of choice. The likes of Amy Johnson, Francis Chichester and C. W. A. Scott will be familiar to most. Less so are such as Violette de Sibour and her husband Jacques, who flew their DH60G a fair way round the world, or Man Mohan Singh, whose lack of navigational skills prompted *The Aeroplane*'s C. G. Grey to write, "[He] has called his aeroplane *Miss India* and he is likely to..."

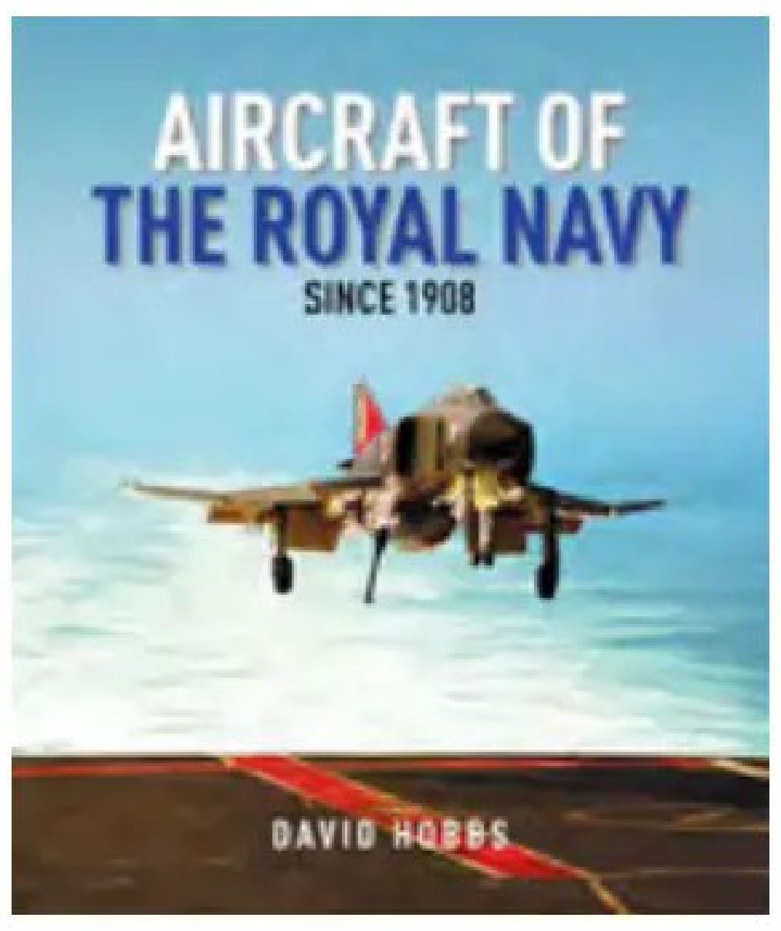
As you'd expect from someone who assisted the Dalai Lama with his autobiography and wrote two biographies of him, the text boasts a very high standard of readability. Pleasingly, Norman isn't blind to the faults of some of those mentioned — he is unafraid, for instance, to make clear the antisemitic views held by individuals such as the American Laura Ingalls, who flew 980 consecutive loops in her Moth. Meanwhile, the input of such luminaries as McKay and Henry Labouchere has helped ensure the accuracy of the technicalities. A most enjoyable book all round — timely, insightful and fun. And, thus, highly recommended. ***BD***

ISBN 978-0-349-14644-7; 9.5 x 6.5in hardback; 328 pages, illustrated; **£25.00**

★★★★

Aircraft of the Royal Navy Since 1908

by David Hobbs
published by Seaforth Publishing



David Hobbs, previously curator of the Fleet Air Arm Museum at Yeovilton, is ideally placed to write this "comprehensive study of every aircraft type ordered for the Royal Navy since 1908". Setting the scene in his preface, Hobbs explains that he has listed aircraft under their original manufacturer, hence, for instance Saunders-Roe — rather than Westland — Wasp. Once having taken this point, the reader will find navigation through this volume a whole lot easier.

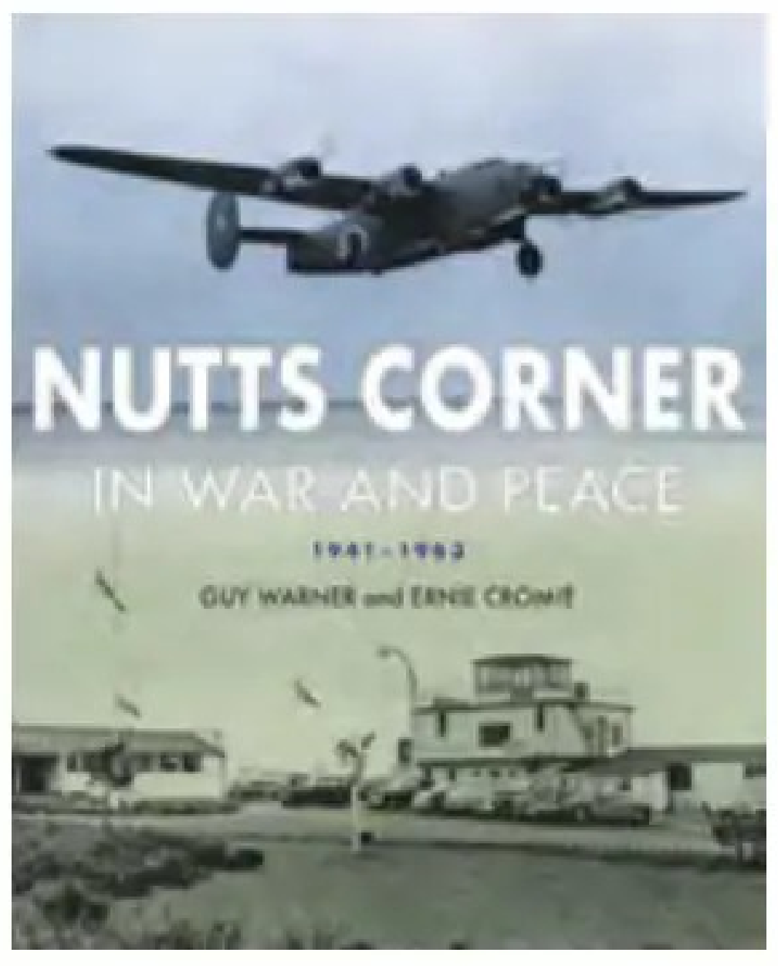
Comparisons will surely made between this and the previous 'bible' on the subject, Owen Thetford's *British Naval Aircraft Since 1912*, first published in 1958 but subsequently revised several times to include 'later types' such as the Phantom FG1. This new volume is less formal in style and is in larger format with better image reproduction, although with no colour apart from on the dust jacket. Hobbs gives his opinions in no uncertain manner where he feels it appropriate. The F-35B, he says, is "the wrong choice for the RN; too complicated, too expensive both to buy and fly and operated by a joint force that appears not to have carrier operations as its first priority". You might very well think that. I couldn't possibly comment. ***DJC***

ISBN 978-1-3990-8952-4; 11.7 x 10.0in hardback; 368 pages, illustrated; **£50.00**

★★★★

Nutts Corner in War and Peace 1941-1963

by Guy Warner and Ernie Cromie
published by Colourpoint Books



Your reviewer is, he must admit, no great fan of many books covering the history of a single airfield. Without being over-critical of what are often labours of love, the results can be little more than a simple chronological account of goings-on, accompanied by too many generic images. Well, part of that is true here as the authors detail the military and civilian activities at Nutts Corner in County Antrim, once among Northern Ireland's most important aerodromes. There *are* unspecific photos, an example being that on page 70 captioned, "A Boeing B-17 Flying Fortress, as flown by 2nd Lieutenant 'Kit' Carson from Goose Bay to Nutts Corner in December 1943". It actually shows B-17G warbird *Sentimental Journey* flying at an airshow in 2014.

However, the range of illustrations actually depicting activities at Nutts Corner, or more closely related to them, is still very wide indeed. Reproduction is generally good, too, and on nice paper. The text draws in material from a fine range of sources, taking the whole book way beyond the standard of many airfield histories. Where else, for instance, will you read about the US Navy's use of Consolidated Coronado flying boats for a regular transport service which stopped off at nearby Lough Neagh? An excellent effort, and a nice tribute to co-author Ernie Cromie, who died before publication. ***BD***

ISBN 978-1-78073-395-1; 10.25 x 8.25in softback; 200 pages, illustrated; **£16.00**

★★★

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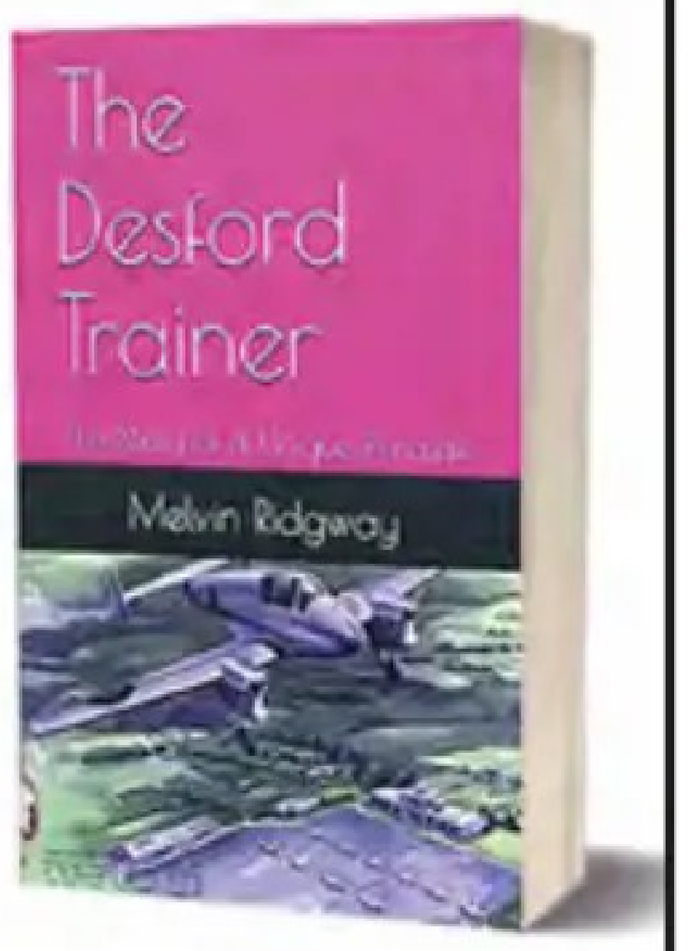
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CANAV Books Introduces … *The Royal Canadian Air Force: 100 Years of Service*

The RCAF is celebrating its Centennial through 2024-25. For this historic landmark, CANAV Books introduces *The Royal Canadian Air Force: 100 Years of Service* in 2 spectacular volumes by Larry Milberry and Hugh A. Halliday. Vol.1 is in print, Vol.2 is due before Centennial ends in April. Beautifully produced, Vol.1 is 384 9x12-inch pages, 300,000+ words, 800+ photos, 2+ kg. All topics are covered in detail from before the RCAF's birth in 1924, through its pioneering 1920s-30s, then come all aspects of the RCAF in all theatres 1939-45.

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Aeroplane Monthly, ISSN 0143-7240 (USPS 16220) is published monthly by Key Publishing Ltd, PO Box 300, Stamford, Lincolnshire, PE9 1NA, UK.

Airfreight and mailing in the USA by agent named World Container Inc., 150-15, 183rd St, Jamaica, NY 11413, USA.

Periodicals postage paid at Brooklyn, NY 11256

Postmaster: Send address changes to *Aeroplane Monthly*, Air Business Ltd, c/o World Container Inc., 150-15, 183rd St, Jamaica, NY 11413, USA

Subscription records are maintained at Key Publishing Ltd, PO Box 300, Stamford, Lincolnshire, PE9 1NA, UK.

Air Business Ltd is acting as our mailing agent.

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Printing

William Gibbons Ltd, Willenhall, UK
ISSN: 0143-7240

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